Appendix A

Climate Records From WRCC

LEWISTOWN FAA AP, MONTANA

Period of Record General Climate Summary - Precipitation

Station:(244985) LEWISTOWN FAA AP															
From Year=1896 To Year=2008															
	Precipitation											Total Snowfall		
	Mean	High	Year	Low	Year	1 Day Max.		>= 0.01 in.	>= 0.10 in.	>= 0.50 in.	>= 1.00 in.	Mean	High	Year
	in.	in.	-	in.	-	in.	dd/yyyy or yyyymmdd	# Days	# Days	# Days	# Days	in.	in.	-
January	0.73	2.75	1978	0.00	1901	0.87	25/1978	8	3	0	0	11.0	33.0	1971
February	0.65	2.22	1914	0.02	1901	2.02	22/1914	7	2	0	0	7.3	18.6	1949
March	1.00	3.81	1902	0.00	1900	1.25	25/1995	9	3	0	0	10.3	27.7	1995
April	1.29	4.50	1900	0.09	1949	4.50	23/1900	9	4	1	0	8.5	37.8	1970
May	2.83	9.16	1981	0.31	1928	2.81	20/1962	12	7	2	1	3.7	29.5	1982
June	3.51	9.56	1923	0.46	1912	3.10	06/1906	13	8	2	1	0.1	2.0	1969
July	1.91	5.97	1928	0.04	1908	2.80	13/1907	9	5	1	0	0.0	0.0	1948
August	1.61	5.54	1985	0.02	1901	2.99	08/2002	8	4	1	0	0.0	0.0	1948
September	1.48	4.92	1941	0.00	1990	1.76	21/1959	8	4	1	0	1.0	9.2	1983
October	1.15	5.80	1908	0.00	1902	3.80	21/1908	7	3	0	0	3.8	18.6	1975
November	0.74	3.97	1897	0.00	1907	1.80	24/1896	7	3	0	0	6.9	16.2	1996
December	0.75	2.36	1977	0.00	1896	0.96	12/1937	8	3	0	0	10.1	30.0	1971
Annual	17.65	28.11	1978	11.15	1956	4.50	19000423	105	48	8	2	62.8	122.1	1982
Winter	2.13	5.87	1978	0.56	1987	2.02	19140222	24	7	0	0	28.5	62.2	1978
Spring	5.12	12.25	1981	1.42	1958	4.50	19000423	30	14	3	1	22.5	64.6	1982
Summer	7.03	15.01	1923	2.27	2003	3.10	19060606	30	17	4	1	0.1	2.0	1969

Fall	3.37	8.05	1908	0.25	1904	3.80	19081021	22	10	1	0	11.7	34.0	1975

Table updated on Jul 15, 2008
For monthly and annual means, thresholds, and sums:
Months with 5 or more missing days are not considered
Years with 1 or more missing months are not considered
Seasons are climatological not calendar seasons

Winter = Dec., Jan., and Feb. Spring = Mar., Apr., and May

Summer = Jun., Jul., and Aug. Fall = Sep., Oct., and Nov.

Western Regional Climate Center, wrcc@dri.edu

LEWISTOWN FAA AP, MONTANA

Period of Record General Climate Summary - Temperature

Station:(244985) LEWISTOWN FAA AP																
From Year=1896 To Year=2008																
	Monthly Averages			Daily Extremes				Monthly Extremes				Max. Temp.		Min. Temp.		
	Max.	Min.	Mean	High	Date	Low	Date	Highest Mean	Year	Lowest Mean	Year	>= 90 F	<= 32 F	<= 32 F	<= 0 F
	F	F	F	F	dd/yyyy or yyyymmdd	F	dd/yyyy or yyyymmdd	F	-	F	-	# Days	# Days	# Days	# Days
January	32.1	9.8	21.0	73	22/1981	-46	28/1929	35.1	2006	-1.8	1950	0.0	12.5	29.3	8.8
February	35.6	12.5	24.0	70	27/1932	-42	17/1936	38.6	1991	-0.2	1936	0.0	9.6	26.5	6.3
March	42.1	19.2	30.6	88	29/1902	-28	03/1896	52.4	1902	14.8	1912	0.0	6.4	27.9	3.0
April	54.1	28.5	41.3	89	29/1939	-17	02/1936	50.3	1910	28.5	1975	0.0	1.5	20.7	0.2
May	63.5	37.0	50.3	98	14/1931	11	06/1929	58.8	1934	44.3	1927	0.2	0.1	8.1	0.0
June	71.7	44.5	58.1	105	21/1900	21	15/1914	67.5	1988	51.0	1951	1.0	0.0	0.9	0.0
July	81.5	49.7	65.6	105	31/1900	27	09/1903	72.9	2007	56.7	1993	5.5	0.0	0.0	0.0
August	80.4	48.2	64.3	103	05/1961	27	25/1910	72.3	1971	58.2	1911	4.7	0.0	0.3	0.0
September	69.2	39.6	54.4	99	09/1909	6	24/1926	62.2	1963	42.8	1965	0.9	0.1	5.0	0.0
October	58.6	31.3	44.9	92	04/1905	-10	30/1935	52.3	1963	34.8	1919	0.0	1.1	16.4	0.2
November	44.3	20.6	32.5	81	13/1905	-30	23/1985	43.9	1949	10.7	1985	0.0	5.2	25.8	2.2
December	35.8	13.4	24.6	74	05/1939	-42	24/1983	36.9	1896	6.3	1983	0.0	10.1	28.8	5.8
Annual	55.7	29.5	42.6	105	19000621	-46	19290128	46.6	1934	37.8	1951	12.4	46.6	189.8	26.5
Winter	34.5	11.9	23.2	74	19391205	-46	19290128	33.0	1992	10.8	1979	0.0	32.2	84.7	20.8
Spring	53.2	28.2	40.7	98	19310514	-28	18960303	47.7	1910	32.9	1975	0.2	8.0	56.7	3.3
Summer	77.8	47.5	62.7	105	19000621	21	19140615	68.0	1961	57.1	1993	11.2	0.0	1.2	0.0

Fall	57.4	30.5	44.0	99	19090909	-30	19851123	50.2	1963	33.2	1985	0.9	6.4	47.3	2.4

Table updated on Jul 15, 2008
For monthly and annual means, thresholds, and sums:
Months with 5 or more missing days are not considered
Years with 1 or more missing months are not considered
Seasons are climatological not calendar seasons

Winter = Dec., Jan., and Feb. Spring = Mar., Apr., and May
Summer = Jun., Jul., and Aug. Fall = Sep., Oct., and Nov.

Western Regional Climate Center, wrcc@dri.edu

Appendix B

MBMG Registered Well Records

Montana Bureau of Mines and Geology
Ground-Water Information Center Spring Report
BIG SPRINGS * LEHMAN SPRING

Plot this site on a topographic map
View water quality for this site

Location Information

GWIC Id:	155347	Source of Data:	
Location (TRS):	14N 19E 05 DBCB	Latitude (dd):	47.0013
County (MT):	FERGUS	Longitude (dd):	-109.3403
DNRC Water Right:		Geomethod:	TRS-TWN
PWS Id:		Datum:	
Block:		Altitude (feet):	
Lot:		Certificate of Survey:	
Addition:		Type of Site:	

Spring Construction Data

There are no construction data available for this spring.

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: BIG SPRING FISH HATCHERY
GWIC Id: 120525

Section 1: Well Owner

Owner Name
MT DEPT FISH WILDLIFE & PARKS
Mailing Address
1420 E SIXTH

City	State	Zip Code
HELENA	MT	

Section 2: Location

Township	Range	Section	Quarter Sections
14N	19E	5	SE¼ SE¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
46.9981	109.3328	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot
FWPL-6		

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: AIR ROTARY

Section 5: Well Completion Date

Date well completed: Thursday, June 07, 1990

Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-1.5	26.8	2				PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
26.8	36.8	2			.010 SLOTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	0	BENTONITE	

Section 7: Well Test Data

Total Depth: 37.3
Static Water Level:
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	14	SANDY CLAY WITH A FEW GRAVEL CLASTS.
14	38	FINE GRAINED SAND.

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: OLYMPUS
License No: MWC-9
Date Completed: 6/7/1990

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: BIG SPRING FISH HATCHERY
GWIC Id: 120526

Section 1: Well Owner

Owner Name
MT DEPT FISH WILDLIFE & PARKS
Mailing Address
1420 E 6TH

City	State	Zip Code
HELENA	MT	

Section 2: Location

Township	Range	Section	Quarter Sections
14N	19E	5	SE¼ SE¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
46.9981	109.3328	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot
FWPL-5		

Section 3: Proposed Use of Water
MONITORING (1)

Section 4: Type of Work
Drilling Method: AIR ROTARY

Section 5: Well Completion Date
Date well completed: Friday, July 06, 1990

Section 6: Well Construction Details
There are no borehole dimensions assigned to this well.

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-0.3	12	2				PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
12	22	2			.010 SLOTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	0	BENTONITE	

Section 7: Well Test Data

Total Depth: 22.5
Static Water Level:
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	2	SANDY GRAVELS SOFT BROWN SANDSTONE CLASTS
2	16.5	SANDY CLAY
16.5	22.5	SANDY GRAVELS. SOFT SANDSTONE CLASTS PREDOMINATE.

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:	
Company:	OLYMPUS
License No:	MWC-9
Date Completed:	7/6/1990

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: BIG SPRING FISH HATCHERY
GWIC Id: 120527

Section 1: Well Owner

Owner Name
MT DEPT OF FISH WILDLIFE AND PARKS
Mailing Address
1420 E 6TH

City	State	Zip Code
HELENA	MT	

Section 2: Location

Township	Range	Section	Quarter Sections
14N	19E	5	SE¼ SE¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
46.9981	109.3328	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot
FWPL-4		

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: AIR ROTARY

Section 5: Well Completion Date

Date well completed: Wednesday, June 06, 1990

Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-0.3	17	2				PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
7	17	2			.010 SLOTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	0	BENTONITE	

Section 7: Well Test Data

Total Depth: 17.4
Static Water Level:
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	2	SAND LOAM
2	12	SANDY CLAY W/MINOR GRAVEL CLASTS.
12	17.4	SANDY GRAVELS. CLASTS COMPOSITION IS PREDOMINATELY SOFT BROWN SANDSTONE.

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:	
Company:	OLYMPUS
License No:	MWC-9
Date Completed:	6/6/1990

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: BIG SPRING FISH HATCHERY
GWIC Id: 120528

Section 1: Well Owner

Owner Name
MT DEPT OF FISH WILDLIFE AND PARKS
Mailing Address
1420 E 6TH

City	State	Zip Code
HELENA	MT	

Section 2: Location

Township	Range	Section	Quarter Sections
14N	19E	5	SE¼ SE¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
46.9981	109.3328	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot
FWPL-7		

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: AIR ROTARY

Section 5: Well Completion Date

Date well completed: Thursday, June 07, 1990

Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	2.4	2				PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
2.4	10.4	2			.010 SLOTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	0	BENTONITE	

Section 7: Well Test Data

Total Depth: 10.4
Static Water Level:
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	10.4	SANDY GRAVELS. GRAY.

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:	
Company:	OLYMPUS
License No:	MWC-9
Date Completed:	6/7/1990

Montana Bureau of Mines and Geology
Ground-Water Information Center Spring Report
CITY OF LEWISTOWN - BIG SPRINGS

Plot this site on a topographic map
View water quality for this site

Location Information

GWIC Id:	1883	Source of Data:	
Location (TRS):	14N 19E 05 DCBB	Latitude (dd):	47.0013
County (MT):	FERGUS	Longitude (dd):	-109.3419
DNRC Water Right:		Geomethod:	MAP
PWS Id:	00271002	Datum:	
Block:		Altitude (feet):	4175
Lot:		Certificate of Survey:	
Addition:		Type of Site:	

Spring Construction Data

There are no construction data available for this spring.

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: COMES DEAN AND JULIE
GWIC Id: 206891

Section 1: Well Owner

Owner Name
COMES DEAN AND JULIE
Mailing Address
HC 87 BOX 5075

City	State	Zip Code
LEWISTOWN	MT	59457

Section 2: Location

Township	Range	Section	Quarter Sections
14N	19E	5	SE¼ NW¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
47.0055	109.3437	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Tuesday, July 01, 2003

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	20	7
20	300	5

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	20	6	0.250		WELDED	STEEL
10	300	4		160.00	SOLVENT WELD	PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
200	240	4		.20	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	20	CEMENT GROUT	
190	250	10/20 SILICA SAND	
250	250	RUBBER PACKER	

Section 7: Well Test Data

Total Depth: 300
Static Water Level: 180
Water Temperature:

Air Test *

12 gpm with drill stem set at 240 feet for 3 hours.
Time of recovery 1 hours.
Recovery water level 180 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	18	HARD GRAY LIMESTONES
18	112	HARD GRAY AND BROWN SANDS AND SHALE
112	205	LIGHT HARD GRAY SHALE AND SAND
205	230	LIGHT GRAY SANDY SHALE MEDIUM HARD AND FRACTURED
230	260	GRAY CLAY AND GRAY SILTSTONE
260	300	BROWN SILTSTONE AND HARD RED SHALE OR RED MUDSTONES

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:	
Company:	CENTRAL
License No:	WWC-581
Date Completed:	7/1/2003

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: GILL DAN
GWIC Id: 138977

Section 1: Well Owner

Owner Name
GILL DAN
Mailing Address
RR 1 CASTLE CREEK

City	State	Zip Code
LEWISTOWN	MT	59457

Section 2: Location

Township	Range	Section	Quarter Sections
14N	19E	5	SW¼ SW¼ NW¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
47.0045	109.3504	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot
		2

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Tuesday, April 06, 1993

Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	19	6				STEEL
10	160	4				PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
120	160	4			1/8X3 SAW PERF

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	19	BENTONITE	

Section 7: Well Test Data

Total Depth: 160
Static Water Level: 67
Water Temperature:

Air Test *

15 gpm with drill stem set at _ feet for 1 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 67 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

Unassigned

From	To	Description
0	1	OVERBURDEN
1	7	RED BROWN CLAY
7	13	TAN LIMESTONE
13	25	BROWN GRAY CLAY
25	29	SANDY SHALE
29	37	BROWN SANDSTONE
37	68	GRAY SHALE
68	95	BROWN SANDSTONE
95	121	GRAY SANDY SHALE
121	160	GRAY SANDSTONE

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: FOUR STAR
License No: WWC-520
Date Completed: 4/6/1993

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: MT DEPT OF HWYS * BIG SPRING NORTH #1
GWIC Id: 151930

Section 1: Well Owner

Owner Name
MT DEPT OF HWYS
Mailing Address

City	State	Zip Code
HELENA	MT	

Section 2: Location

Township	Range	Section	Quarter Sections
14N	19E	5	NW¼ SE¼ NW¼ NW¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
47.0087	109.3484	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water
GEOTECH (1)

Section 4: Type of Work
Drilling Method:

Section 5: Well Completion Date
Date well completed: Thursday, July 16, 1992

Section 6: Well Construction Details
There are no borehole dimensions assigned to this well.
There are no casing strings assigned to this well.
There are no completion records assigned to this well.
Annular Space (Seal/Grout/Packer)

There are no annular space records assigned to this well.

Section 7: Well Test Data

Total Depth: 45.2
Static Water Level: 10.6
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks
BORING NO: 4-66-92 PROJECT NO: RS 466-1(1)0 HOLE NO: 1 PURPOSE: BRIDGE FOUNDATION GEOTECH: LORENZEN

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	18.5	GRAVEL MED DENSE BROWN SILTY SANDY GRAVEL
18.5	23.7	SILT VERY LOOSE TAN SILT W/ A TRACE OF GRAVEL
23.7	27	SAND LOOSE TO DENSE TAN SILTY SAND
27	34.1	GRAVEL DENSE TAN SILTY GRAVEL
34.1	45.2	SHALE VERY HARD GREY WEATHERED SHALE

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: STARZ
License No: -
Date Completed: 7/16/1992

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: MT DEPT OF HWYS * BIG SPRING NORTH #2
GWIC Id: 151931

Section 1: Well Owner

Owner Name
MT DEPT OF HWYS
Mailing Address

City	State	Zip Code
HELENA	MT	

Section 2: Location

Township	Range	Section	Quarter Sections
14N	19E	5	NW¼ SE¼ NW¼ NW¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
47.0087	109.3484	TRS-TWN	NAD27

Altitude	Method	Datum	Date
4129.5			

Addition	Block	Lot

Section 3: Proposed Use of Water
GEOTECH (1)

Section 4: Type of Work
Drilling Method:

Section 5: Well Completion Date
Date well completed: Wednesday, July 15, 1992

Section 6: Well Construction Details
There are no borehole dimensions assigned to this well.
There are no casing strings assigned to this well.
There are no completion records assigned to this well.
Annular Space (Seal/Grout/Packer)

There are no annular space records assigned to this well.

Section 7: Well Test Data

Total Depth: 35.7
Static Water Level: 11.3
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks
BORING NO: 4-65-92 PROJECT NO: RS 466-1(1)0 HOLE NO: 2 PROJECT NAME: BIG SPRIG NORTH PURPOSE: BRIDGE FOUNDATION

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	17.9	GRAVEL - LOOSE TO MEDIUM DENSE BROWN SILTY SANDY GRAVEL W/SOME CLAYEY SILT LAYERS
17.9	35.7	SHALE - VERY HARD GRAY WEATHERED SHALE

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:	
Company:	STARZ
License No:	-
Date Completed:	7/15/1992

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: CHANSEN FRED
GWIC Id: 27091

Section 1: Well Owner

Owner Name
N/A

Section 2: Location

Township	Range	Section	Quarter Sections
15N	19E	31	SE¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
47.0145	109.3563	TRS-TWN	NAD27

Altitude	Method	Datum	Date
4150			

Addition	Block	Lot

Section 3: Proposed Use of Water
DOMESTIC (1)

Section 4: Type of Work
Drilling Method:

Section 5: Well Completion Date
Date well completed: Thursday, January 01, 1948

Section 6: Well Construction Details
There are no borehole dimensions assigned to this well.
Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	0	8				

There are no completion records assigned to this well.
Annular Space (Seal/Grout/Packer)

There are no annular space records assigned to this well.

Section 7: Well Test Data

Total Depth: 60
Static Water Level:
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log
Geologic Source
Unassigned
Lithology Data

There are no lithologic details assigned to this well.

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:	
Company:	
License No:	-
Date Completed:	1/1/1948

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map
View hydrograph for this site
View water quality for this site

Site Name: BRADLEY ED AND LINDA
GWIC Id: 27093

Section 1: Well Owner

Owner Name
OLIVER STEVENS
Mailing Address
P.O. BOX 1649;

City	State	Zip Code
LEWISTOWN	MT	59457

Section 2: Location

Township	Range	Section	Quarter Sections
15N	19E	32	SE¼ NW¼ SW¼ SW¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
47.0148	109.3517	NAV-GPS	NAD27

Altitude	Method	Datum	Date
4185			

Addition	Block	Lot

Section 3: Proposed Use of Water
DOMESTIC (1)

Section 4: Type of Work
Drilling Method: FORWARD ROTARY

Section 5: Well Completion Date
Date well completed: Thursday, January 01, 1981

Section 6: Well Construction Details
There are no borehole dimensions assigned to this well.

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	12	5				STEEL
12	105	4.5		160.00		PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
105	185	4.5			160 PSI PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	35	CEMENT	

Section 7: Well Test Data

Total Depth: 185
Static Water Level: 83
Water Temperature:

Air Test *

18 gpm with drill stem set at _ feet for 1.5 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 140 feet.

* *During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
221ELLS - ELLIS GROUP

From	To	Description
0	2	OVER BURDEN & GRAVEL
2	50	SANDSTONE
50	86	SANDSTONE WITH LIMESTONE LAYERS
86	103	GRAY SHALE
103	185	SANDSTONE WITH BENTONITE LAYERS

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: THATCHER
License No: WWC-410
Date Completed: 1/1/1981

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: HAUGEN FAMILY TRUST
GWIC Id: 191590

Section 1: Well Owner

Owner Name
AUDREY A HAUGN TRUSTEE
Mailing Address
HC 87 BOX 5190

City	State	Zip Code
LEWISTOWN	MT	59457

Section 2: Location

Township	Range	Section	Quarter Sections
15N	19E	32	NE¼ NE¼ NW¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
47.0243	109.3421	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Wednesday, June 06, 2001

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	200	5

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	28	6	0.250			STEEL
10	220	4		220.00		PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
160	200	6		1/8X6	SAW SLOTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	28	BENTONITE	

Section 7: Well Test Data

Total Depth: 200
Static Water Level: 64
Water Temperature:

Air Test *

20 gpm with drill stem set at 180 feet for 2 hours.
Time of recovery 0.75 hours.
Recovery water level 64 feet.
Pumping water level _ feet.

* *During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	18	SILTY SAND AND CLAY
18	124	GRAVEL RED GRAY MAROON SHALE SOME COAL SPECS
124	132	TAN LIMESTONES WITH BENTONITE STRINGERS AND GREEN SILTSTONE
132	135	DARK GRAY SHALE
135	145	GRAY GREEN SANDSTONE
145	180	SHALE BACKED SANDSTONE GREEN TO GRAY
180	200	SHALE BACKED SANDSTONE GREEN TO GRAY WITH GRAY SHALES

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: CENTRAL
License No: WWC-581
Date Completed: 6/6/2001

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: HANGEN FAMILY TRUST
GWIC Id: 193091

Section 1: Well Owner

Owner Name
BALEK LINDA AND THOMAS
Mailing Address
HC 87 PO BOX 5191

City	State	Zip Code
LEWISTOWN	MT	59457

Section 2: Location

Township	Range	Section	Quarter Sections
15N	19E	32	NE¼ NW¼ NE¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
47.0243	109.3367	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Friday, June 08, 2001

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	38	7
28	400	5

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	38	6	0.250			STEEL
10	400	4		220.00		PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
360	390	4			1/8X6IN SLOTTED SAW PERFS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	38	CEMENT	
355	355	RUBBER PACKER	

Section 7: Well Test Data

Total Depth: 400
Static Water Level: 265
Water Temperature:

Air Test *

18 gpm with drill stem set at 380 feet for 3 hours.
Time of recovery 0.5 hours.
Recovery water level 265 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	50	GRAY TO SALT AND PEPPER SANDSTONE
50	100	LOST CIRCULATION AT 50 FEET VERY FRACTURED PLUG BACK 100 TO 40 WITH CEMENT
100	347	GRAY BROWN RED MAROON SHALES COAL STREAKS AND GRAY TO GREEN SANDSTONE LAYERS DARK GRAY SHALES
347	350	GRAY FINE GRAIN SANDSTONE
350	400	GRAY TO GREEN SHALED BACKED SANDSTONE

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:	
Company:	CENTRAL
License No:	WWC-581
Date Completed:	6/8/2001

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: MANUEL TED
GWIC Id: 27092

Section 1: Well Owner

Owner Name

N/A

Section 2: Location

Township	Range	Section	Quarter Sections
15N	19E	32	SW¼ SW¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
47.0124	109.3488	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water

DOMESTIC (1)
STOCKWATER (2)

Section 4: Type of Work

Drilling Method:

Section 5: Well Completion Date

Date well completed: Sunday, January 01, 1961

Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	0	6				

There are no completion records assigned to this well.

Annular Space (Seal/Grout/Packer)

There are no annular space records assigned to this well.

Section 7: Well Test Data

Total Depth: 125
Static Water Level: 60
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

Unassigned

Lithology Data

There are no lithologic details assigned to this well.

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:	
Company:	
License No:	-
Date Completed:	1/1/1961

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map

Site Name: PATTERSON GRANT
GWIC Id: 169980

Section 1: Well Owner

Owner Name
PATTERSON GRANT
Mailing Address
PO BOX 33

City	State	Zip Code
MEDICINE LAKE	MT	59247

Section 2: Location

Township	Range	Section	Quarter Sections
15N	19E	32	NE¼ NE¼ NW¼

County	Geocode
FERGUS	

Latitude	Longitude	Geomethod	Datum
47.0243	109.3421	TRS-TWN	NAD27

Altitude	Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method:

Section 5: Well Completion Date

Date well completed: Saturday, September 12, 1987

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	18	7
18	90	5

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	18	6				STEEL
10	90	4				PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
70	90	4			DRILL

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	18	BENTONITE	

Section 7: Well Test Data

Total Depth: 90
Static Water Level: 60
Water Temperature:

Air Test *

20 gpm with drill stem set at _ feet for 0.5 hours.
Time of recovery 0 hours.
Recovery water level _ feet.
Pumping water level 0 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

Unassigned

Lithology Data

There are no lithologic details assigned to this well.

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:	
Company:	SINGLEY
License No:	WWC-398
Date Completed:	9/12/1987

Appendix C

ATSDR ToxFAQs™ for PCBs

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

POLYCHLORINATED BIPHENYLS

Division of Toxicology ToxFAQs™ **February 2001**

This fact sheet answers the most frequently asked health questions (FAQs) about polychlorinated biphenyls. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

What happens to PCBs when they enter the environment?

- ❑ PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
- ❑ PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.
- ❑ PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.
- ❑ PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How might I be exposed to PCBs?

- ❑ Using old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, that were made 30 or more years ago. These items may leak small amounts of PCBs into the air when they get hot during operation, and could be a source of skin exposure.
- ❑ Eating contaminated food. The main dietary sources of PCBs are fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products.
- ❑ Breathing air near hazardous waste sites and drinking contaminated well water.
- ❑ In the workplace during repair and maintenance of PCB transformers; accidents, fires or spills involving transformers, fluorescent lights, and other old electrical devices; and disposal of PCB materials.

How can PCBs affect my health?

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

How likely are PCBs to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

How can PCBs affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

How can families reduce the risk of exposure to PCBs?

❏ You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.

❏ Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.

❏ Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.

❏ If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to PCBs?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Appendix D

FWP Suction Dredge Pilot Test Report

PILOT PROJECT TO EVALUATE THE EFFICACY OF A SUCTION DREDGE TO REMOVE PCB-LADEN PAINT CHIPS FROM STREAMBOTTOM SEDIMENTS IN BIG SPRING CREEK

by

Don Skaar
Montana Fish, Wildlife and Parks
December 2007

Purpose and scope

PCB-laden paint chips are found in the sediments of Big Spring Creek in all geomorphic stream types (pools, runs, riffles) and at depths of up to at least one foot (Camp Dresser McKee 2005 Risk Assessment). The removal of these chips may be required as part of the remediation process to reduce risk to humans and sensitive ecological receptors (fish, fish-eating birds, aquatic insects). Therefore, it is necessary to evaluate different technologies that can remove these chips. Suction dredging is a technology that holds particular promise due to its presumed ability to remove both large and small paint chips while leaving larger natural streambed materials in place.

The opportunity arose in fall 2006 to test the suction dredge system operated by Streamside Systems, LLC. Important issues to evaluate during this demonstration were: 1) The efficiency of the dredge at removing sediment and paint chip particles both at the surface and at greater depths; 2) The speed of the system, i.e. the rate of removal of sediment and paint chips; 3) The collateral damage to stream banks and vegetation at the site; 4) Logistic issues that occur as a result of the dredging, e.g. time to setup, ability to control suspended sediment, space required for trailers, pumps and vehicles.

Streamside System Suction dredge

The suction dredge was a system developed by Streamside Systems, LLC. of Findlay, Ohio, which they call a "Sand Wand." The pilot test consisted of using the Sand Wand system to remove sand- and silt/clay-sized sediment from Big Spring Creek. This system is unique in that the mobile suction head includes a one-inch water jet operating at 90 gallons of water per minute (gpm) to dislodge large streambottom materials, and a larger suction hose to remove the fine materials liberated by the action of the water jet. The suction hose draws about 340 gallons gpm into a 3-inch diameter hose. The diameter and flow rate of both the jet and the suction hose can be modified to respond to site-specific needs.

Site characteristics

The portion of Big Spring Creek immediately downstream from the footbridge in the Kiwanis City Park near the upper unit of the Big Spring State Fish Hatchery was chosen as the site to conduct the pilot project. This site was chosen because: 1) previous sampling had demonstrated that PCB paint chips were plentiful in the sediments at the site; 2) the vehicle access to the site was within 100 feet of the stream; 3) streambanks at the site were low and provided for ease of movement of the dredge and personnel; and 4) site characteristics were deemed to be about as challenging as any that would be encountered along the stream, i.e. the armor layer of the stream at this site consisted primarily of large cobbles and water velocities were high.

In order to minimize the effects of turbidity generated by the dredging, a deflector was erected to force most of the streamflow away from the area to be dredged. This deflector consisted of two concrete barriers (total length about 20 feet) lowered in place with an excavator to deflect most of the streamflow. At the downstream end of the barriers, about 30 feet of sheep fence was wired to fence posts pounded into the streambed, and lined with irrigation cloth to prevent the remaining streamflow from entering the dredge area (photo #1).

The dredged slurry of water and sediment was pumped into a 10,000-gallon frac tank placed on the streambank. At the conclusion of the pilot project, the water was pumped from the frac tank into a tanker truck and hauled to Hobson. There, it was land applied on a field where there was no chance of entry to surface waters. The sediment in the frac tank was dried and hauled to the Montana Waste Systems High Plains Landfill in Great Falls for disposal.

Photo 1: Sand wand in operation. Concrete barriers wrapped with plastic in foreground.

Results

Chronology of activities and general observations. The dredging demonstration occurred on the afternoon of November 8, 2006. The dredge was operated intermittently between 1 and 3 pm. Pauses occurred to improve performance of the dredge, to evaluate the effects of the dredging or for the operator to explain his activities. The area of streambottom that was dredged was estimated to be about 60-75 ft^2, and approximately 6,000 gallons of water and 1,400 pounds of sediment were pumped into the frac tank. Several times during the demonstration we requested the operator to try to dislodge materials as deeply as possible. He did this by holding the mobile head of the wand over one spot and working it back and forth continually while trying to dig deeper and deeper into the sediment. After this was attempted for a few minutes, we dug with our hands down in the sediment to feel for a change in the quantity of fines or consolidation of the materials. Based on these subjective measures, we felt that the dredge was dislodging materials and removing fines at depths somewhere between 4-6 inches (see photos 1,2 and 3).

Photo 2: Closeup of streambed after suction dredging.

Photo 3: Closeup of mobile head of the sand wand, showing supply line for jet (small hose) and suction line (large hose).

Effects of suction dredging on streambed particle size distribution. The effectiveness of the suction dredge was evaluated by comparing the size distribution of sediment particles in dredged and undredged areas of Big Spring Creek. Nine sediment samples were collected for this purpose on December 20, 2006: five samples from within the dredged area and four samples outside the perimeter of the dredged area (Figure 1). Samples were collected with a McNeil core sampler (Photo #4) that allowed sediment to be collected by hand from depths of 5-7 inches. These samples were placed in plastic bags, transported to Helena, and processed at the USDA Helena Ranger District laboratory. There, samples were dried in an oven and loaded onto a stack of nine brass sieves with progressively smaller mesh sizes from top to bottom. The sieves were placed on an automatic shaker helped speed the sorting of particles. Sediment retained in each sieve was then weighed and recorded.

Results indicated that sediment samples from the undredged area had considerable variability in the sizes of particles, but could broadly be described as bimodal, with peaks in the size range 25.4 mm or greater and also in the size range 0.074-0.85 mm (Figure 2). Core samples from the dredged area revealed a similar bimodal pattern to the sediment, but the fraction of smaller sediment (0.074-0.85 mm) was much reduced relative to the samples from the undredged area, indicating that the dredging had removed these smaller fractions (Figure 3). When these data were plotted on a semi-log scale and with the quantity of sediment in each sieve on a cumulative basis, the lines representing the four core samples from undredged areas are curvilinear, with the steepest slopes corresponding to those bimodal peaks (Figure 4). The corresponding plot for cores from dredged areas shows a “sag” in the line, primarily due to the drop in the amount of fine sediments smaller than 0.85 mm (Figure 5).

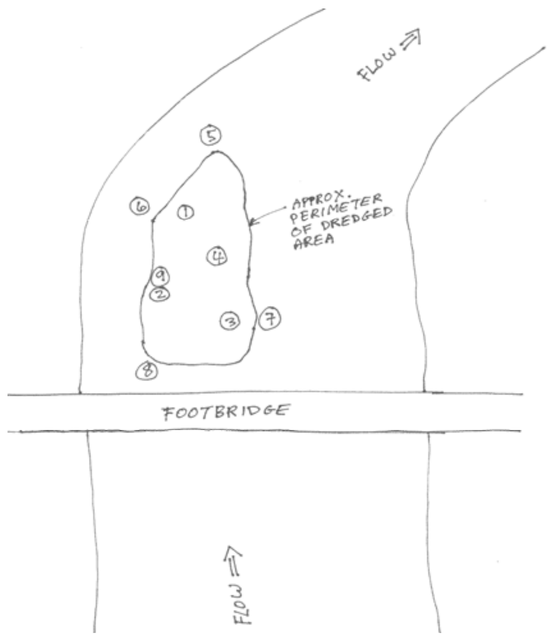


Figure 1. Drawing of the location of McNeil core samples.

Photo #4. McNeil corer shown in the dredged area of Big Spring Creek.

Figure 2. Particle size of sediment in 5-7" depth cores of undredged streambed

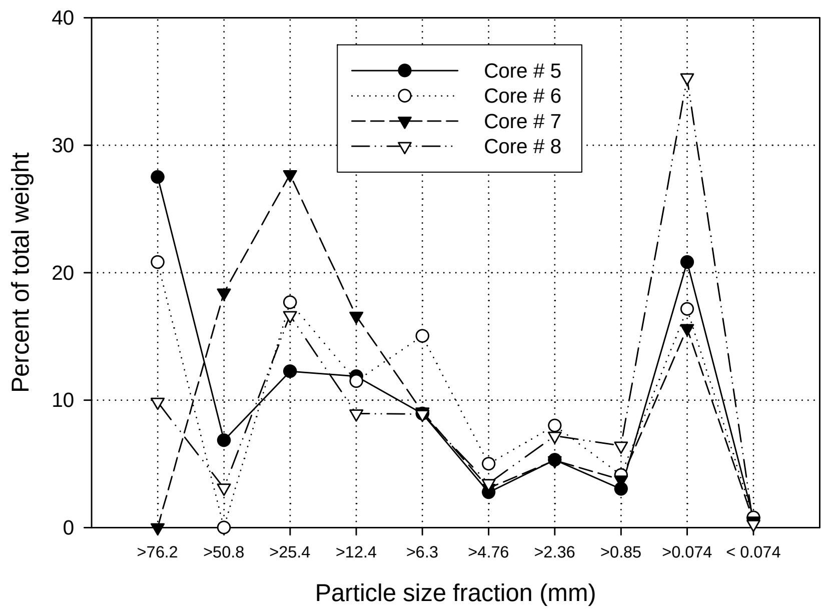


Figure 3. Particle size of sediment in 5-7" depth cores of suction dredged area

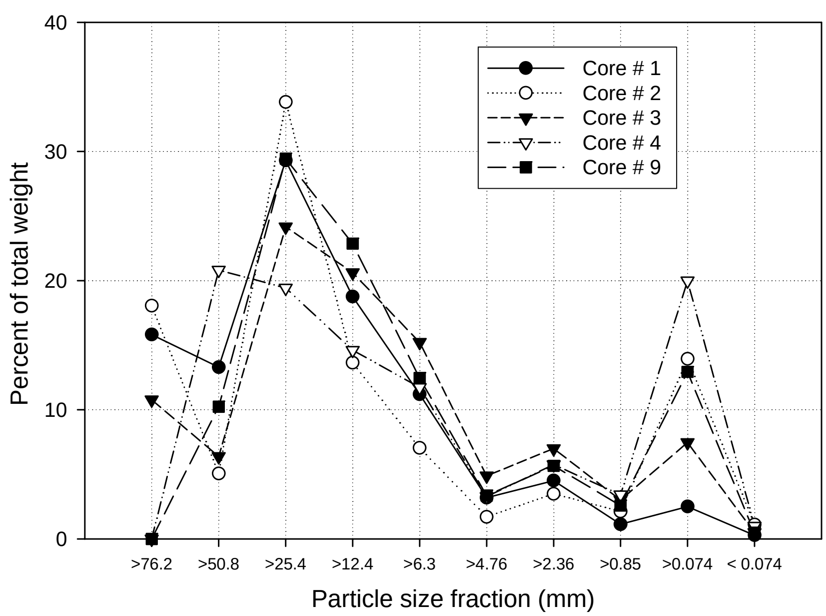


Figure 4. Undredged Area Particle Size Distribution

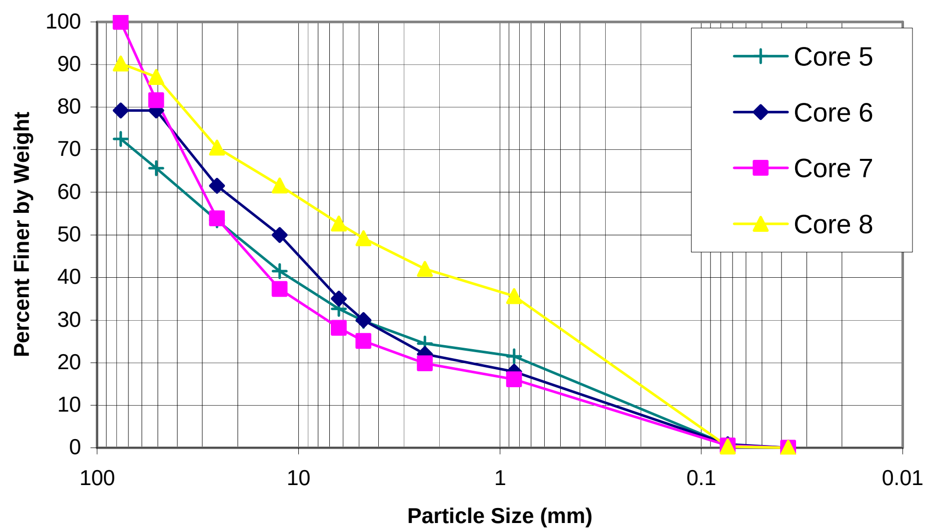
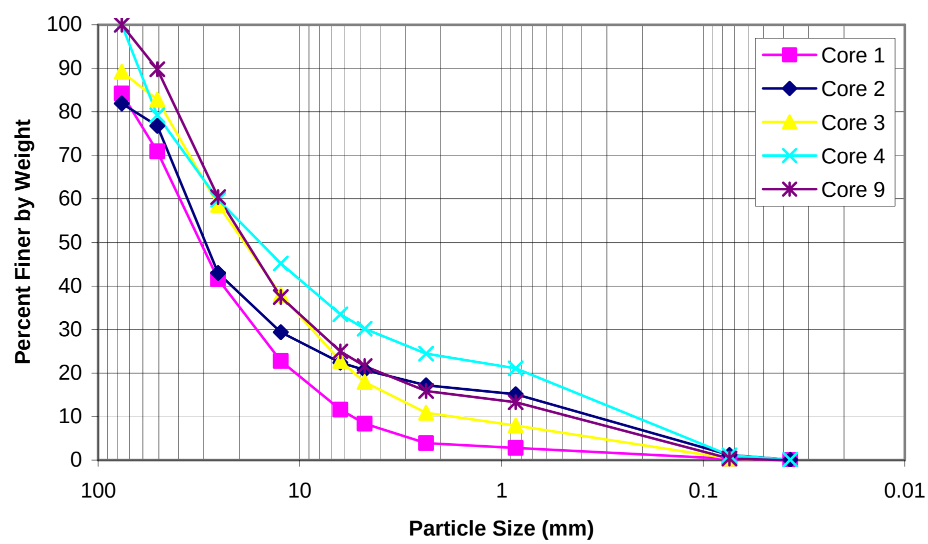
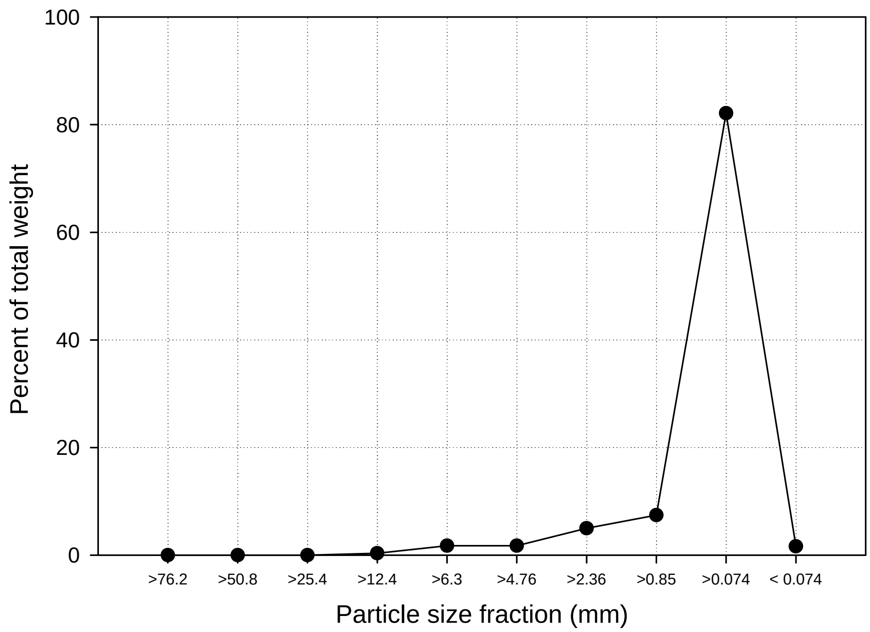


Figure 5. Dredged Area Particle Size Distribution



The particle sizes of dredged material was determined by sieving a sub-sample of approximately one pound of sediment taken from random spots in the frac tank. The maximum size of dredged material was in the size range of 12.4-25.4 mm, while the minimum size particle was less than the smallest sieve mesh size of 0.074 mm (Figure 6). The vast majority (over 80%) of the dredged material was in the size range of 0.074-0.85 mm, which explains the diminution of the peak for that size fraction in the samples from the dredged area relative to samples from the undredged area (compare Figures 2 and 3).

Figure 6. Particle size of dredged sediment sampled in frac tank.



Paint chip removal. Evidence of the ability of the suction dredge to remove paint chips comes from a comparison of paint chips in stream sediments from the dredged and undredged areas as well as an examination of paint chips in the dredged material in the frac tank. This was accomplished by manually picking paint chips from each sieve fraction using a pair of forceps. For the two fractions smaller than 0.85 mm, it was only possible to identify paint chips with the aid of a dissecting microscope. For the smallest size fraction (<0.074 mm) we could not remove them from the surrounding sediment matrix without picking the sediment as well. Therefore, the amount of chips in this size fraction remains unquantified, even though we observed them under the microscope.

Results showed that almost all paint chips in the sediments from undredged areas were between 0.85 and 12.4 mm, while most chips in the sediments from dredged areas were between 0.85 and 4.76 mm (Figure 7). In addition, the quantity of paint chips in each size fraction was substantially lower in cores from the dredged areas than cores from undredged areas. The distribution of paint chip sizes in the dredged material from the frac tank was heavily skewed toward the size fractions between 2.36 and 6.3 mm (Figure 8). This distribution is quite different than that of the core samples from undredged areas, suggesting that chips are broken up into smaller sizes during the dredging process. Figure 8 shows no paint chips in the smallest size fraction (<0.074 mm), even though microscopic examination revealed chips to be present. As described above, removal of paint chips from this fraction was not possible.

Figure 7. Paint chip weight as a percent of size fraction weight

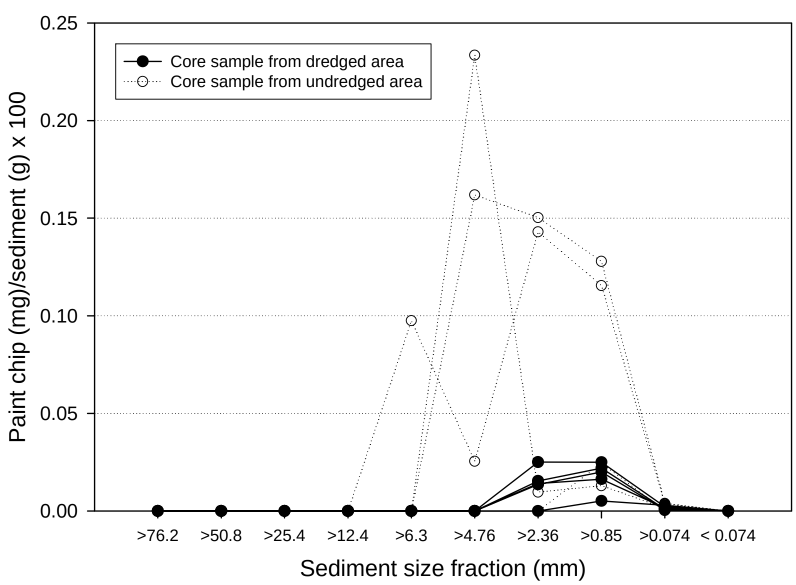
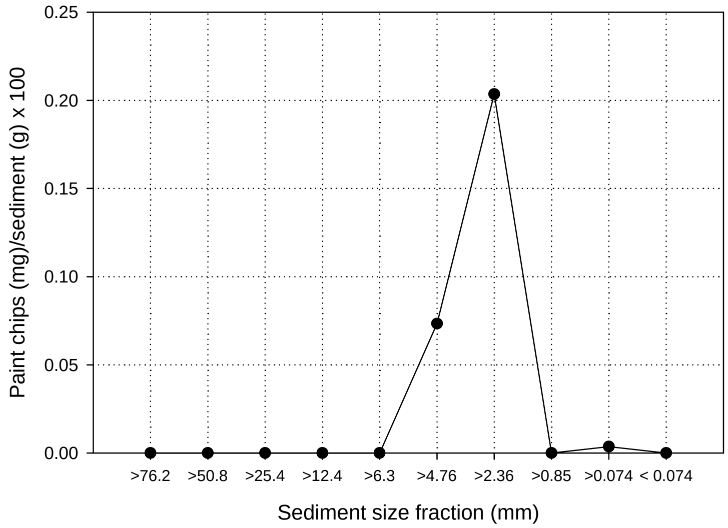


Figure 8. Paint chip weight as a percent of size fraction weight in dredged material in the frac tank.



The amount of paint chips as a proportion of total sediment is shown in Table 1. For the five samples from dredged areas, the percent of the material that was paint chips ranged from 0.000512-0.00286%, with a mean value of 0.00136%. For samples from the undredged areas, the percent of paint chips ranged from 0.000799-0.0285%, with a mean value of 0.0151%. The dredged mean value is 9.0% of the undredged mean value, indicating that about 91% of the paint chips were removed by the dredging action. The confidence in this number is low however, due to the small sample size and high level of variation among samples.

The percent of paint chips in the frac tank sediment was 0.014%, which was actually lower than the mean level in the undredged material (0.0151%). This is not what would be expected, because the suction dredge is preferentially removing the fine materials, and as such it would be expected that the paint chips would increase as a percentage of sample weight in dredged material. The explanation for this may be that many of the paint chips are being broken into very small sizes during the dredge operation and that we were unable to identify and remove them from the frac tank material. This hypothesis is supported by calculations in the next section of this report.

Concentration of PCBs in sediments and dredged material. Samples were taken of sediment, paint chips and water from the frac tank for PCB analysis. Three samples were taken of the dredged sediment material in the frac tank, with results ranging from 0.33-2.5 µg/g, and a mean value of 1.44 µg/g (Table 2). Paint chips (all red colored) from this same dredged material were removed and analyzed, and the results of two samples were quite variable (15 and 113 µg/g). This may be due to the variability in the rate at which PCBs are degraded or solubilized from individual paint chips. Alternatively, it may also be due to there being a number of different vintages of red paint that were used at the hatchery that may have had different levels of PCBs. Any particular sample of paint

Table 1. Paint chips as a percentage of sediment weight in core samples and dredged material in the frac tank.	
Site	**Paint chips as a percent of sample weight**
Site 1 (dredged)	0.00097
Site 2 (dredged)	0.00098
Site 3 (dredged)	0.00266
Site 4 (dredged)	0.00167
Site 9 (dredged)	0.000512
	Mean = 0.00136
Site 5 (undredged)	0.000799
Site 6 (undredged)	0.013
Site 7 (undredged)	0.0183
Site 8 (undredged)	0.0285
	Mean = 0.0151
Frac tank	0.014

Table 2. Results of PCB analyses taken from various media during suction dredge project. Analyses conducted at Energy Laboratories using EPA Method SW8082. Sediment results are on a dry weight basis.	
Media	**PCB concentration**
Water overlaying sediment in frac tank. (11/9/06)	<0.5 µg/L
Sediment in frac tank (Sample A)	2.5 µg/g
Sediment in frac tank (Sample B)	0.33 µg/g
Sediment in frac tank (Sample C)	1.5 µg/g
Paint chips from dredged material (all size fractions combined)	15.0 µg/g
Paint chips from dredged material (duplicate of above)	113 µg/g

chips may therefore have a different vintage and concentration of PCBs from any other sample.

With the analyses presented in Table 2, it is possible to estimate the amount of PCBs removed by the suction dredge operation. Since there were 1400 pounds (636 kg) of sediment (dry weight basis) recovered in the frac tank, and this sediment had an average PCB concentration of 1.44 µg/g, then we can calculate there was 636 kg x 1.44 mg/kg = 915 mg PCBs removed during the suction dredge activity. A second method to estimate the amount of PCBs comes by multiplying the quantity of paint chips in the dredged sediment by the concentration of PCBs in the paint chips. The average paint chip PCB concentration is 64 µg/g (average of 15 and 113 µg/g) and the amount of paint chips as a percent of total sediment was 0.014%. Therefore, since there were 91.6 g of paint chips (636,000 g sediment x 0.00014), and the concentration of PCBs in paint was 64 ug/g, the estimated amount of PCBs is 91.6 g x 64 ug/g = 5,862 µg or 5.862 mg PCBs in the dredged material. The quantity of PCBs estimated with this method is about 156 times less than with the first method (5.8 mg vs. 915 mg), and this disparity may be due to the acknowledged difficulty in identifying and removing paint chips from the small sieve size fractions (<0.85 mm). Therefore it seems likely that the second method, which requires the quantification of paint chips, is probably less accurate than the first method.

Summary and Implications for Full Scale Suction Dredging

Issues related to mobilization/demobilization and dredge operation. This pilot project was inadequate for the purpose of understanding all the issues surrounding mobilization and demobilization. The dredge system itself, consisting of hoses, pumps, mobile head and generator could easily be transported to a site in one or two pickup trucks. In the pilot project, a frac tank was used to store and settle water and sediment. In a full-scale operation, the sediment/water slurry would be pumped out of the stream channel to some containment basin on land. After settling, the water would be pumped back to the stream and the sediment dried and hauled off to a landfill facility. The need for secondary basins to settle very fine particulates is possible, but has not been evaluated. During the pilot project, water drawn from the frac tank about 18 hours after cessation of suction dredging did not have any visible turbidity. However, during a full-scale operation, it would be desirable to settle material and discharge back into the stream within a short time span in order to keep the size of the containment basins as small as possible. In the pilot project, we found that paint chips are broken into smaller sizes as a result of the dredging and this may have consequences for the time it takes to settle materials during a full-scale operation. One approach would be the addition of some flocculent to reduce the time to settle all materials. Streamside Systems has used crushed oyster shells for this purpose and this might be worth testing on Big Spring Creek.

Another unanswered question is whether the action of suction dredging leads to more PCBs being released into the water column, due to the breakup of the paint chips and the mixing and oxygenation of sediments. The only water sample taken from the frac tank during this project had a no-detect at 0.5 µg/L (Table 2), which is much higher than the aquatic life water quality standard for PCBs (0.014 µg/L) or the human health standard (0.00064 µg/L). The requirements that will be established for discharge water during remedial actions is unknown at this point, but may have an impact on the settling times required and the possible use of flocculants.

Issues related to the impacts of suction dredging on the Big Spring Creek stability and aquatic life. No sampling was done during the pilot project to evaluate these issues. However, it is probably safe to speculate that most aquatic invertebrates and macrophytes living on substrate that is dredged are going to be either displaced or destroyed by the power of the water jet or passing through the suction pump. Unfortunately, these impacts are likely to be impossible to avoid. However, it should be possible to mitigate for impacts to aquatic life living downstream of the dredge location. The downstream effects that will be of greatest concern are those to fish eggs and larvae and will be due primarily to the increased suspended sediment that is released during the dredging. Ways to mitigate for this will include scheduling the dredging for times when eggs and larvae are not in gravels close by, and erecting barriers around the dredge site to minimize the amount of sediment that is carried downstream. During the pilot project, the concrete barriers only acted to deflect the water around the top 50% of the work site. The lower half of the worksite had a barrier made of sheep fencing covered with irrigation cloth, which was not as effective as the concrete barriers. Hatchery personnel at the lower unit about 0.7 miles downstream did observe a slight coloring of the water during the dredge operation.

During the pilot project, an effort was made to observe the space needs of personnel for getting equipment to and from the creek and the impact of this foot travel on streambank stability. At the site, the Streamside personnel had to move up and down a 2-3 foot high streambank that was well vegetated and slightly sloped back from a vertical angle. After 3-4 hours of continual use by three people, this bank remained in good condition. Based on these observations, it appears that this dredge could be operated at virtually any site along Big Spring Creek without destroying vegetation or streambanks, as long as there is an opening in the vegetation that allows for the passage of a single person carrying hoses and the mobile head of the Sand Wand.

Issues related to the effectiveness of suction dredging. In this project, about 91% of the PCBs were estimated to have been removed from the sediment down to a depth of 5-7 inches. The implications of this for aquatic life, and especially fish, can only be estimated after making several assumptions. One assumption is that the PCBs available for uptake by aquatic life are those in the surficial sediments, probably closely represented by the data here from depths of 5-7 inches. PCBs in deeper sediments are probably not bioavailable. It is also assumed that most if not all of these PCBs have remained bound up in the paint chips. A final assumption is that smaller sizes of paint chips are more bioavailable to aquatic invertebrates (and fish via the food chain) than are large paint chips. Based on these three assumptions, we believe that a removal of 91% of the paint chips will translate to lower levels of PCBs in aquatic insects and fish muscle. Even though the action of the dredge is to break up paint chips into small size fractions (and hence make them more bioavailable), our results show that the amount of paint chips in small size fractions is still substantially decreased in sediments from dredged areas relative to sediments from undredged areas (Figure 7).

In this project, the demonstration by Streamside Systems personnel lasted about two hours, although the actual time that the dredge was in operation was estimated to be close to one hour. In this time, 60-75 square feet were dredged and 1,400 pounds of sediment were removed. It is difficult to determine if this would be typical dredge rate during a full-scale operation. Factors which would slow the operation include large, heavily armored substrate which is not easily dislodged by the water jet or low-hanging heavy vegetation which hinders movement. The presence of beds of aquatic macrophytes is difficult for this system to handle because the plants will clog the suction hose. During the pilot project, 10-15 minutes was expended raking the streambottom to dislodge the rooted vegetation in advance of dredging activities. One factor which might speed up the operation include an operator with experience at the site who is able to fine-tune the flow rates used for the water jet and suction pump.

Appendix E

Description of Federal and State Applicable or Relevant and Appropriate Requirements

1.0 INTRODUCTION

Authority to require and oversee cleanup of polychlorinated biphenyls (PCBs) in Big Spring Creek is given to the Environmental Protection Agency (EPA) by the Toxic Substances Control Act (TSCA). EPA Region 8 in Denver has concluded that because there are no numeric cleanup standards in TSCA for stream sediments, remediation decisions requiring a "risk-based" evaluation (40 CFR 761.61(c)) are the most appropriate for Big Spring Creek. The Remedial Investigation/Feasibility Study (RI/FS) process used under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is being followed to accomplish this risk-based evaluation.

Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), certain provisions of the current National Contingency Plan (the NCP), 40 CFR Part 300, and guidance and policy issued by the Environmental Protection Agency (EPA) require that remedial actions taken pursuant to Superfund authority shall require or achieve compliance with substantive provisions of applicable or relevant and appropriate standards, requirements, criteria, or limitations from state environmental and facility siting laws, and from federal environmental laws, at the completion of the remedial action, during the implementation of the remedial action, or both, depending on the nature of the requirements, unless a waiver is granted[1]. If contaminant- or location-specific ARARs are not being met before the commencement of a remedial action, it is not necessary to invoke a waiver to justify their non-attainment during the action, although they must be attained (or appropriately waived) for remedial action to be complete and the remedy to be successful[2]. These requirements are threshold standards that any selected remedy must meet, unless adequate basis for a waiver is present. See Section 121 (d) (4) of CERCLA, 42 U.S.C. § 9621 (d) (4); 40 CFR § 300.430 (f) (1). EPA calls standards, requirements, criteria, or limitations identified pursuant to section 121 (d) "ARARs," or applicable or relevant and appropriate requirements.

ARARs are either applicable or relevant and appropriate. Applicable requirements are those standards, requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance found at a CERCLA site (40 CFR § 300.5). Relevant and appropriate requirements are those standards, requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances found at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site such that their use is well suited to the particular site. Id. Factors which may be considered in making this determination are presented in 40 CFR 300.§ 400(g) (2). Compliance with both applicable and relevant and appropriate requirements is mandatory, unless compliance is waived. 42 U.S.C. § 121(d)(4); 40 CFR § 300.430(f)(ii)(B).

Each ARAR or group of related ARARs identified here is followed by a specific statutory or regulatory citation, a classification describing whether the ARAR is applicable or relevant and appropriate, and a description which summarizes the requirements, and addresses how and when compliance with the ARAR will be measured (some ARARs will govern the conduct of the

[1] See 55 Fed. Reg. 8666, 8755 (March 8, 1990)
[2] EPA CERCLA Compliance with Other Laws Manual 1-8 (OSWER # 9234.1-01, August 1988)

remedial action, some will define the measure of success of the remedial action, and some will do both)[3]. The descriptions given here are provided to allow the user a reasonable understanding of the requirements without having to refer constantly to the statute or regulation itself. However in the event of any inconsistency between the law or regulations and the summary provided in this document, the applicable or relevant and appropriate requirement is ultimately the requirement as set out in the law or regulation, rather than any paraphrase provided here.

Also contained in this list are policies, guidance or other sources of information which are "to be considered" in the design and implementation of a Record of Decision (ROD). Although not enforceable requirements, these documents are important sources of information which EPA may consider during implementation of the remedy, especially in regard to the evaluation of the remedy's success in addressing public health and environmental risks.

Finally, this list contains a non-exhaustive list of other legal provisions or requirements which should be complied with during the implementation of a ROD[4].

ARARs are divided into contaminant-specific, location-specific, and action-specific requirements, as described in the NCP and EPA guidance. For contaminant-specific ARARs, ARARs are listed according to the appropriate media.

Contaminant-specific ARARs include those laws and regulations governing the release to the environment of materials possessing certain chemical or physical characteristics or containing specific chemical compounds. Contaminant-specific ARARs generally set health or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of cleanup activities because they are in specific locations. Location-specific ARARs relate to the geographic or physical position of the site, rather than to the nature of site contaminants. Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous substances.

Only the substantive portions of the requirements are ARARs[5]. Administrative requirements are not ARARs and thus do not apply to actions conducted entirely on-site. Administrative requirements are those which involve consultation, issuance of permits, documentation, reporting, record keeping, and enforcement. The CERCLA program has its own set of administrative procedures which assure proper implementation of CERCLA. The application of additional or conflicting administrative requirements could result in delay or confusion[6]. Provisions of statutes or regulations which contain general goals that merely express legislative intent about desired outcomes or conditions but are non-binding are not ARARs[7].

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[3] 40 CFR § 300.435(b)(2); Preamble to the Proposed NCP, 53 Fed. Reg. 51440 (December 21, 1988);Preamble to the Final NCP, 55 Fed. Reg. 8755-8757 (March 8, 1990)

[4] 40 CFR § 300.400(g)(3); 40 CFR § 300.515(h)(2); Preamble to the Final NCP, 55 Fed. Reg. 8744-8746 (March 8, 1990)

[5] 40 CFR § 300.5. See also Preamble to the Final NCP, 55 Fed. Reg. 8756-8757 (March 8, 1990)

[6] Preamble to the Final NCP, 55 Fed. Reg. 8756-8757 (March 8, 1990); Compliance with Other Laws Manual, Vol.1, pp. 1-11 - 1-12

[7] Preamble to the Final NCP, 55 Fed. Reg. 8746 (March 8, 1990)

Many requirements listed here are promulgated as identical or nearly identical requirements in both federal and state law, usually pursuant to delegated environmental programs administered by both EPA and the states, such as many of the requirements of the federal Clean Water Act and the Montana Water Quality Act. The Preamble to the final NCP states that such a situation results in citation to the state provision as the appropriate standard, but treatment of the provisions as a federal requirement. ARARs and other laws which are unique to state law are identified separately by the State of Montana.

The ARAR analysis is based on section 121(d) of CERCLA, 42 U.S.C. § 9621 (d); CERCLA Compliance with Other Laws Manual, Volumes I and II; OSWER Directives 9234.1-01 and -02 (August 1988 and August 1989 respectively; various CERCLA ARARs Fact Sheets issued as OSWER Directives; the Preamble to the Proposed NCP, 53 Fed. Reg. 51394 et seq. (December 21, 1988); the Preamble to the Final NCP, 55 Fed. Reg. 8666-8813 (March 8, 1990); and the NCP, 40 CFR Part 300; other applicable guidances; and the substantive provisions of law discussed in this document.

2.0 FEDERAL ARARS

2.1 Federal Contaminant-Specific Requirements

2.1.1 Toxic Substances Control Act (Applicable)

The Toxic Substances Control Act (TSCA) and implementing regulations (15 USC §§ 2601, 40 CFR Part 761) regulate PCB manufacturing, processing, distribution in commerce, and use prohibitions. TSCA provides EPA with authority to require testing of both new and existing chemical substances entering the environment, and to regulate them where necessary. EPA guidance provides that the form and concentration of the PCB contamination be determined on an “as found” basis, rather than on the original form and concentration of PCB materials prior to their release. PCBs cannot be diluted, however, to escape TSCA requirements.

Soil and sediment, which are classified as PCB remediation wastes, must be cleaned up to less than one part per million for use in high occupancy areas. The EPA Regional Administrator may require cleanup to more stringent cleanup levels based on proximity to sensitive areas, including wetlands and sport fisheries. The decontamination standard for water is less than or equal to 0.5 μg/l for unrestricted use.

40 CFR Part 761.61 provides the cleanup and disposal options for PCB remediation wastes. Options for cleanup and disposal of PCB remediation wastes include a) self-implementing on-site cleanup and disposal of PCB remediation waste, b) performance based disposal, and c) risk-based disposal approval.

2.1.2 Groundwater Standards - Safe Drinking Water Act (Applicable)[8]

The National Primary Drinking Water Standards (40 CFR Part 141), better known as maximum contaminant levels and maximum contaminant level goals (MCLs and MCLGs), are applicable to the Big Spring Creek PCB project because the Big Spring and the aquifer system that feeds it is used as a public water system for the City of Lewistown, as defined in the Safe Drinking Water Act, 42 U.S.C. § 300f(4).

Use of these standards for this action is fully supported by EPA regulations and guidance. The Preamble to the NCP clearly states that MCLs are relevant and appropriate for groundwater that is a current or potential source of drinking water (55 Fed. Reg. 8750, March 8, 1990), and this determination is further supported by requirements in the regulations governing conduct of the RI/FS studies found at 40 CFR § 300.430(e)(2)(i)(B). EPA's guidance on Remedial Action for Contaminated Groundwater at Superfund Sites states that "MCLs developed under the Safe Drinking Water Act generally are ARARs for current or potential drinking water sources." MCLGs which are above zero are applicable under the same conditions (55 Fed. Reg. 8750-8752, March 8, 1990). See also, State of Ohio v. EPA, 997 F.2d 1520 (D.C. Cir. 1993), which upholds EPA's application of MCLs and non-zero MCLGs as ARAR standards for groundwater which is a potential drinking water source.

As noted earlier, standards such as the MCL and MCLG standards are promulgated pursuant to both federal and state law. Under the Safe Drinking Water Act, EPA has granted the State of Montana primacy in implementation of the Safe Drinking Water Act. The State has promulgated its own public water supply ground water standards through the Public Water Supply Act for most contaminants of concern, primarily through incorporation by reference of the federal standard. These standards, when the same or more stringent than the federal standard, are also identified here.

Chemical	**MCLG**	**MCL**
Polychlorinated biphenyls (PCBs)	Zero	0.0005 mg/l[9]

These standards incorporate potentially relevant and appropriate Resource Conversation Act (RCRA) standards for groundwater found at 40 CFR Part 264, Subpart F, which is incorporated pursuant to state law at ARM 17.53.801. The RCRA standards are the same or less stringent than the MCLs or MCLGs identified above. These standards would also be applicable to the Big Spring Creek ambient surface water, if State water quality standards are less stringent for human health protection or are not present. In such a case, they would be measured as dissolved standards for ambient surface water.

2.1.3 Surface Water - Ambient and Point Source Discharges - Clean Water Act(Applicable)

CERCLA and the NCP provide that federal water quality criteria (FWQC) developed pursuant to the federal Clean Water Act, 33 U.S.C. §§ 1251 et seq., that match designated or anticipated surface water uses are the usual surface water standards to be used at Superfund cleanups, as relevant and appropriate standards, unless the state has promulgated surface water quality

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[8] 42 U.S.C. §§ 300f et seq.
[9] 40 CFR § 141.61 (c)

standards pursuant to the delegated state water quality act. The State of Montana has designated uses for the Missouri River and its tributaries including Big Spring Creek, and has promulgated specific numeric water quality standards accordingly. Those standards as well as other surface water standards are included in the State ARARs identified in Section 3.1.1 below. If State standards for the contaminants listed in Section 3.1.1 below are changed to be less stringent than existing FWQC, then FWQC will be identified as the appropriate ARARs.

2.1.4 Surface Water - Ambient and Point Source Discharges - Temporary Standards (Applicable)

The remedy that is selected from Big Spring Creek may cause unavoidable conditions in which surface water ARAR standards are exceeded. Section 121(b)(1) of CERCLA requires that remedial actions be protective of human health and the environment. In addition to that independent requirement, Section 121(d) generally provides that remedial actions shall meet ARARs, unless those requirements are waived pursuant to section §121(d)(4) under appropriate site-specific circumstances.[10] In determining whether or not any water quality criteria under the Clean Water Act is relevant and appropriate under the circumstances of the release or threatened release, the designated or potential use of the surface or groundwater, the environmental media affected, the purposes for which such criteria were developed, and the latest information available must be considered. Such a waiver must be applied consistent with the substantive requirements of sections 308 and 318 of the State's Clean Water Act, §§ 75-5-308, 75-5-318, MCA, as described in Section 3.1.1.1.

2.1.5 Air Standards - Clean Air Act (Applicable)

Federal air quality standards are not currently exceeded in the Big Spring Creek PCB project area. Limitations on air emissions resulting from cleanup activities or emissions resulting from wind erosion of exposed hazardous substances are set forth in the action-specific requirements, below, in Sections 2.3.3 and 3.3.3. Certain OSHA standards for protection of workers would be monitored for during construction activities to ensure protection of workers' health.

2.2 Federal Location-Specific Requirements

2.2.1 Toxic Substances Control Act (Applicable)

TSCA facility requirements provide siting guidance and criteria for storage (761.65), incinerators (761.70), and chemical waste landfills (761.75).

2.2.2 Fish and Wildlife Coordination Act (Applicable)

These standards are found at 16 U.S.C. §§ 661 et seq. and 40 CFR § 6.302(g). They require that federally funded or authorized projects ensure that any modification of any stream or other water body affected by a federally funded or authorized action provide for adequate protection

[10] ARAR waivers are also discussed in §300.430(f)(1)(ii)(C) of the 1990 National Oil and Hazardous Substances Pollution Contingency Plan (the NCP).

of fish and wildlife resources. Compliance with this ARAR necessitates EPA consultation with the U.S. Fish and Wildlife Service (USFWS) and the State of Montana Department of Fish, Wildlife, and Parks. Consultation will occur with these agencies during the selection of the selected remedy, and further consultation with these agencies will occur during cleanup implementation, and specific mitigative or other measures may be identified to achieve compliance with this ARAR. The purpose of consultation is to develop measures to prevent, mitigate, or compensate for project-related losses to fish and wildlife.

2.2.3 Floodplain Management Order (Applicable)

This requirement (40 CFR Part 6, Appendix A, Executive Order No. 11,988) mandates that federally funded or authorized actions within the 100-year floodplain avoid, to the maximum extent possible, adverse impacts associated with development of a floodplain. Compliance with this requirement is detailed in EPA's August 6, 1985, "Policy on Floodplains and Wetlands Assessments for CERCLA Actions."

2.2.4 Protection of Wetlands Order (Applicable)

This requirement (40 CFR Part 6, Appendix A, Executive Order No. 11,990) mandates that federal agencies and potentially responsible parties (PRPs) avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists. Section 404(b)(1), 33 U.S.C. § 1344(b)(1), also prohibits the discharge of dredged or fill material into waters of the United States. Together, these requirements create a "no net loss" of wetlands standard. This ARAR is not a ban on wetland destruction, but is instead a mandate for no net loss of wetlands, with a preference for avoiding wetland destruction if practicable.

2.2.5 The Endangered Species Act (Applicable)

This statute and implementing regulations (16 U.S.C. §§ 1531 - 1544, 50 CFR Part 402, and 40 CFR § 6.302(h)) require that any federal activity or federally authorized activity may not jeopardize the continued existence of any threatened or endangered species known to live or to have lived in the affected environment or destroy or adversely modify a critical habitat. This ARAR requires EPA to ensure that the selected remedy is sufficiently protective of the environment containing the threatened or endangered species, with an emphasis on reducing the risks from the contaminants of concern to the listed species described in the EPA risk assessment to an acceptable level, with consideration given to the special status of the listed or threatened species - see 40 CFR Sections 300.430(d)(2)(vii) and (e)(2)(i)(G) and EPA Guidance Document OSWER Dir. No. 9285.7-28P, Ecological Risk Assessment and Risk Management principles for Superfund Sites (October, 1999) page 3; and to ensure that the selected remedy is implemented in a manner such that effects on any existing threatened or endangered species from the active remedy implementation activities are avoided or mitigated - see page 4-12 of the CERCLA Compliance with Other Laws Manual: Volume II (EPA August 1989).

2.2.6 The National Historic Preservation Act (Relevant and Appropriate)

This statute and implementing regulations (16 U.S.C. § 470 et seq, 40 CFR § 6.301(b), 36 CFR Part 800) require federal agencies or federal projects to take into account the effect of any federally assisted undertaking or licensing on any district, site building, structure, or object that is included in, or eligible for, the Register of Historic Places. If effects cannot be avoided reasonably, measures should be implemented to minimize or mitigate the potential effect. In addition, Indian cultural and historical resources must be evaluated, and effects avoided, minimized, or mitigated.

2.2.7 Archaeological and Historic Preservation Act (Applicable)

The statute and implementing regulations (16 U.S.C. § 469 et seq., 40 CFR § 6.301(c)) establish requirements for evaluation and preservation of historical and archaeological data, including Indian cultural and historic data, which may be destroyed through alteration of terrain as a result of federal construction projects or a federally licensed activity or program. If eligible scientific, prehistorical, or archaeological data are discovered during site activities, they must be preserved in accordance with these requirements.

2.2.8 Historic Sites, Buildings, and Antiquities Act (Applicable)

This statute and implementing regulations (16 U.S.C. § 461 et seq., 40 CFR § 6.310(a)) state that “in conducting an environmental review of an EPA action, the responsible official shall consider the existence and location of natural landmarks using information provided by the National Park Service pursuant to 36 CFR § 62.6(d) to avoid undesirable impacts upon such landmarks.

2.2.9 Migratory Bird Treaty (Applicable)

This requirement (16 U.S.C.§§ 703 et seq.) establishes a federal responsibility for the protection of the international migratory bird resource and requires consultation by EPA with the USFWS during remedial design and remedial construction to ensure that the cleanup of the site does not unnecessarily impact migratory birds. Specific mitigative measures may be identified for compliance with this requirement as appropriate for performance by the persons who implement the remedy.

2.2.10 Bald Eagle Protection Act (Applicable)

This requirement (16 U.S.C. §§ 668 et seq.) establishes a federal responsibility for protection of bald and golden eagles, and requires consultation by EPA with the USFWS during remedial design and remedial construction to ensure that any cleanup of the site does not unnecessarily adversely affect the bald and golden eagle. Specific mitigative measures may be identified for compliance with this requirement as appropriate, and will be done by the persons who implement any selected remedy.

2.2.11 Resource Conservation and Recovery Act (Relevant and Appropriate)

Any discrete waste units created or actively managed at the site cleanup must comply with the siting restrictions and conditions at 40 CFR § 264.18 (a) and (b). These sections require management units to be designed, constructed, operated, and maintained to avoid washout, if they are within or near the current 100-year flood plain.

2.2.12 Native American Grave Protection and Repatriation Act, 25 U.S.C. § 3001 et seq.; 43 CFR §§ 10.1 - 10.17 (Applicable or Relevant and Appropriate)

NAGPRA and its implementing regulations provide for the disposition of Native American remains and objects inadvertently discovered on federal or tribal lands after November, 1990. 25 U.S.C. Section 3002(d). If the response activities result in the discovery of Native American human remains or related objects, the activity must stop while the head of the federal land management agency (if federal lands are involved) and appropriate Indian tribes are notified of the discovery. After the discovery, the response activity must cease and a reasonable effort must be made to protect the Native American human remains or related objects. The response activity may later resume. 42 CFR Section 10.4. Accordingly, depending on the facts of the discovery and the location of the response action, NAGPRA could be applicable or relevant and appropriate to the response action.

2.3 Federal Action-Specific Requirements

2.3.1 Toxic Substances Control Act (Applicable)

TSCA establishes prohibitions and requirements for the manufacturing, processing, distribution in commerce, use, disposal, storage, and marking of PCBs. 40 CFR Part 761 includes provisions for incineration, disposal, storage for disposal, chemical waste landfills, decontamination, clean-up policy, record keeping, and reporting for PCBs. Subpart D of 40 CFR 761, as revised June 29, 1998, with technical corrections in June 1999, contains the following applicable provisions regarding PCBs:

- 40 CFR Part 761.50 identifies disposal requirements for various PCB waste types.

- 40 CFR Part 761.61 addresses cleanup and disposal options for PCB remediation waste, which includes PCB-contaminated sediments and dredged materials. Disposal options for PCB remediation waste include disposal in a high-temperature incinerator, an approved chemical waste landfill, or a facility with a coordinated approval under 40 CFR Part 761.77. PCB remediation waste containing PCBs at concentrations less than 50 ppm may be disposed of off site in an approved disposal facility for the management of municipal solid waste, or in a disposal facility approved under 40 CFR part 761. 40 CFR Part 761.61(c) allows a EPA Regional Administrator to approve a risk-based disposal method that will not pose an unreasonable risk of injury to human health or the environment.

- 40 CFR 761.65 states that PCB waste must be removed from storage within one year from the time it was removed from service for disposal, and identifies storage facility and container requirements. An exemption from this regulation exists for containerized non-liquid PCBs (soil, rags, debris), which may be stored for up to 30 days from the date they were removed from service for disposal at a facility not meeting the technical requirements. A request for an extension of up to one additional year may be made to the USEPA Regional Administrator. PCBs may be stored at facilities in compliance with RCRA provisions (RCRA section 3004 or 3006). Storage in floodplains is prohibited. This section may be applicable should dredged materials be stored before incineration or land disposal.

- 40 CFR Part 761.70 covers the incineration of PCBs. Incinerators for the burning of PCBs must be approved by the EPA Regional Administrator for incinerators operating only in Region II or the Director, Exposure Evaluation Division for multi-region facilities, pursuant to 40 CFR Part 761.70(d), which lists application requirements. Specific technical requirements for incineration of non-liquid PCBs are found in 40 CFR Part 761.70(b).

- 40 CFR Part 761.75 applies to facilities used for land disposal of PCBs. In general, a chemical waste landfill for PCBs must be approved by the USEPA Regional Administrator. The landfill must meet technical requirements that include, but are not limited to, the following: soil consistency surrounding the landfill (e.g., either permeability < 10^{-7} cm/sec or a synthetic liner); siting requirements (not in flood zones; not hydraulically connected to surface water); flood protection; topography; and appropriate record maintenance (40 CFR 761.75 (b)).

- 40 CFR Part 761.79 provides decontamination standards and procedures for removing PCBs that are regulated for disposal from water, organic liquids, and other materials.

2.3.2 Solid Waste (Applicable), Surface Mining Control and Reclamation (Relevant and Appropriate), and RCRA (Relevant and Appropriate) Requirements[11]

The following requirements apply to on-site disposal of contaminated sediments retained at the site. Debris waste which is disposed of on site must comply with applicable solid waste requirements and the identified relevant and appropriate RCRA requirement.

1. Requirements described at 40 CFR §§ 257.3-1(a), 257.3-3, and 257.3-4, governing waste handling, storage, and disposal, including retention of the waste, in general[12], and 257.3-5b, for application to land used for the production of food-chain clops.

2. For any discrete waste units containing sediments which are created or retained and actively managed at the Site, reclamation and closure regulations found at 30 CFR Parts

[11] If any hazardous wastes as defined by RCRA or the Montana Hazardous Waste Act are encountered or generated during implementation of the remedy, substantive provisions of the Montana Hazardous Waste Act, §§ 75-10-401 et seq., MCA, and its implementing regulations at ARM 17.54.101 et seq., would be applicable to the handling, management, treatment, storage, disposal, and transportation of such wastes. In addition, other laws, such as substantive provisions of the federal Toxic Substances Control Act, are applicable to materials governed by that statute encountered or wastes governed by that statute generated during the remedial action. All off site handling of regulated RCRA or TSCA wastes must comply with all legal requirements, including the requirements of those laws.

[12] Solid waste regulations are promulgated pursuant to the federal Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901 et seq. They are applicable regulations, although the State of Montana has the lead role in regulating solid waste disposal in the State of Montana.

816 and 784, governing coal and to a lesser extent, non-coal mining, are relevant and appropriate requirements[13].

3. Portions of RCRA regulations found at 40 CFR §§ 264.116 and .119(a) and (b) (governing notice and deed restrictions) are relevant and appropriate requirements for the waste management units created or actively managed at the Site.

2.3.3 Air Standards - Clean Air Act (Applicable)

These standards, promulgated pursuant to section 109 of the Clean Air Act[14], are applicable to releases into the air from any cleanup activities.

Particulate matter that is 10 microns in diameter or smaller (PM-10): No person shall cause or contribute to concentrations of PM-10 in the ambient air which exceed:

- 150 μg/m^3 of air, 24 hour average, no more than one expected exceedance per calendar year;
- 50 μg/m^3 of air, annual average.

These regulations are promulgated at ARM 17.8.223 as part of a federally approved SIP, pursuant to the Clean Air Act of Montana, §§ 75-2-101 et seq., MCA. Corresponding federal regulations are found at 40 CFR § 50.6.

Ambient air standards under section 109 of the Clean Air Act are also promulgated for carbon monoxide, hydrogen sulfide, nitrogen dioxide, sulfur dioxide, and ozone. If emissions of these compounds were to occur at the site in connection with any cleanup action, these standards would also be applicable. See ARM 17.8.222 and .223, and 40 CFR Part 50.

2.3.4 Point Source Controls - Clean Water Act (Applicable)

If point sources of water contamination are retained or created by any remediation activity, applicable Clean Water Act standards would apply to those discharges. The regulations are discussed in the contaminant-specific ARAR section, above, and in the State of Montana identification of ARARs. These regulations would include storm water runoff regulations found at 40 CFR Parts 121, 122, and 125 (general conditions and industrial activity conditions). These would also include requirements for best management practices and monitoring found at 40 CFR §§ 122.44(i) and 440.148, for point source discharges.

2.3.5 Dredge and Fill Requirements (Applicable)

Regulations found at 40 CFR Part 230 address conditions of or prohibitions against depositing dredge and fill material into water of the United States. If remediation activities would result in an activity subject to these regulations, they would be applicable. The scope of these regulations has been altered significantly in a 1998 court decision and regulatory responses

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[13] The Surface Mining Control and Reclamation Act is promulgated at 30 U.S.C. §§ 1201 - 1326.
[14] 42 U.S.C. §§ 7401 et seq.

found at 66 Fed. Reg. 4549 (January 17, 2001 - effective date temporarily suspended pending further review, 66 FR 10367 [February 15, 2001]).

2.3.6 Underground Injection Control (Relevant and Appropriate)

Requirements found at 40 CFR Part 144, promulgated pursuant to the Safe Drinking Water Act, allow the re-injection of treated groundwater into the same formation from which it was withdrawn, and addresses injection well construction, operation, maintenance, and capping/closure. These regulations would be applicable to any reinjection of treated groundwater.

2.3.7 Transportation of Hazardous or Contaminated Waste (Relevant and Appropriate)

40 CFR Part 263 establishes regulations for the transportation of hazardous waste. These regulations would govern any on-site transportation of contaminated material. Any off-site transportation would be fully subject to applicable regulations and permitting.

3.0 STATE OF MONTANA ARARS

As provided by Section 121 of CERCLA, 42 U.S.C. § 9621, only those state standards that are more stringent than any federal standard and that have been identified by the state in a timely manner are appropriately included as ARARs.

3.1 Montana Contaminant-Specific Requirements

3.1.1 Water Quality

3.1.1.1 Surface Water Quality Standards - Ambient and Point Source - Montana Water Quality Act (Applicable)

Under the Montana Water Quality Act, §§ 75-5-101 et seq., MCA, the state has promulgated water quality standards to protect, maintain, and improve the quality and potability of the state's surface water for water supplies, wildlife, fish and aquatic life, agricultural, industry, recreation, and other beneficial uses. Except as waived during construction activities by EPA as described in Section 2.1.4. above, and except as explained below concerning the in-stream standards, the requirements listed below are applicable water quality standards with which any remedial action must comply. These requirements must be met upon completion of the remedial action (although operation and maintenance may continue after compliance).

ARM 17.30.610 (1)(e)(iii) (Applicable) classifies the waters of the Big Spring Creek as B-1. The B-1 classification standards are contained in ARM 17.30.623 (Applicable) of the Montana water quality regulations. This section states:

Waters classified B-1 are to be maintained for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.

The B-1 classification standards at ARM 17.30.623 include the following criteria:

1. the water quality standard for Escherichia coli (E-coli) must be kept within specified limits according to season;

2. dissolved oxygen concentration must not be reduced below the levels given in department Circular DEQ-7;

3. induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

4. the maximum allowable increase above naturally occurring turbidity is 5 nephelometric turbidity units;

5. temperature increases must be kept within prescribed limits;

6. no increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except as permitted in 75-5-318, MCA), settleable solids, oils, floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife;

7. true color must not be increased more than five color units above naturally occurring color;

8. concentrations of carcinogenic, bioconcentrating, toxic, radioactive, nutrient, or harmful parameters which may not exceed the applicable standards set forth in the current version of Circular DEQ-7;

9. dischargers issued permits under the nondegradation rules (ARM Title 17, chapter 30, subchapter 13) may not cause receiving water concentrations to exceed the applicable standards specified in Circular DEQ-7 when stream flows equal or exceed the design flows specified in ARM 17.30.635(4); and

10. it is not necessary that wastes be treated to purer condition than the natural condition of the receiving water as long as the minimum target requirements, adopted pursuant to 75-5-306, MCA, are met.

The Circular DEQ-7 levels are listed below for the primary contaminant of concern:

Polychlorinated Biphenyls	Acute	No standard
	Chronic	0.014 µg/l
	Human Health	0.00064 µg/l

Section 75-5-308, MCA, allows DEQ to grant short-term exemptions from the water quality standards or short-term use that exceeds the water quality standards for the purpose of allowing certain emergency remediation activities. Such exemptions typically extend for a period of 30-60 days. However, any exemption must include conditions that minimize to the extent possible the magnitude of the violation and the length of time the violation occurs. In addition, the conditions must maximize the protection of state waters by ensuring the maintenance of beneficial uses immediately after termination of the exemption. Water quality and quantity monitoring and reporting may also be included as conditions. Also, pursuant to 75-5-318, MCA, of the State Clean Water Act, an exemption from surface water quality standards may be authorized by the department under certain conditions, and this may apply to construction and dredging activities associated with sediment removal options.

Additional restrictions on any discharge to surface waters are included in:

- ARM 17.30.637 (Applicable) which prohibits discharges containing substances that will:(a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines; (b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials; (c) produce odors, colors or other conditions which create a nuisance or render undesirable tastes to fish flesh or make fish inedible; (d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; (e) create conditions which produce undesirable aquatic life.

- ARM 17.30.637 also states that no waste may be discharged and no activities conducted which, either along or in combination with other waste activities, will cause violation of surface water quality standards.

3.1.1.2 Montana Pollutant Discharge Elimination System (MPDES) - Stormwater and Other Point Sources (Applicable)

ARM 17.30.1203 (Applicable), adopts and incorporates the provisions of 40 CFR Part 125 for criteria and standards for the imposition of technology-based treatment requirements in MPDES permits. Although the permit requirement would not apply to on-site discharges, the substantive requirements of Part 125 are applicable, i.e., for toxic and nonconventional pollutants treatment must apply the best available technology economically achievable (BAT); for conventional pollutants, application of the best conventional pollutant control technology (BCT) is required. Where effluent limitations are not specified for the particular industry or industrial category at issue, BCT/BAT technology based treatment requirements are determined on a case by case basis using best professional judgment (BPJ). See CERCLA Compliance with Other Laws Manual, Vol. I, August 1988, p. 3-4 and 3-7. These State standards would apply to point source discharges created within the Big Spring Creek PCB project area. This requirement does not change the possibility of a waiver of Circular DEQ-7 standards during construction and the substitution of temporary standards.

Under ARM 17.30.601, ARM 17.30.1101 et seq., and ARM 17.30.1301 et seq., the Montana Department of Environmental Quality has issued general stormwater permits for certain activities. The substantive requirements of the following permits are applicable for the following activities:

- For construction activities: General Permit for Storm Water Discharges Associated with Construction Activity, Permit No. MTR 100000 (April 16, 2007);

- For mining activities: General Permit for Storm Water Discharges Associated with Mining and with Oil and Gas Activities, Permit No. MTR300000 (January 1, 2008);

- For industrial activities: General Permit for Storm Water Discharges Associated with Industrial Activity, Permit No. MTR000000 (October 1, 2006).

- For small municipal separate storm sewer systems (MS4): General Permit for Storm Water Discharges Associated With Small Municipal Separate Storm Sewer Systems (MS4), Permit No. MTR040000 (January 1, 2005).

Generally, the permits listed above require the permittee to implement Best Management Practices (BMP) and to take all reasonable steps to minimize or prevent any discharge which has a reasonable likelihood of adversely affecting human health or the environment. However, if there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with the activity, the substantive standards associated with an individual MPDES permit or alternative general permit may be required. A related mine reclamation requirement is set out in ARM 17.24.633 (relevant and appropriate), which requires that all surface drainage from disturbed areas that have been graded, seeded or planted must be treated by the best technology currently available (BTCA) before discharge. Sediment control through BTCA practices must be maintained until the disturbed area has been reclaimed, the revegetation requirements have been met, and the area meets state and federal requirements for the receiving stream.

3.1.1.3 Groundwater Standards (Applicable)

ARM 17.30.1006 (Applicable) classifies groundwater into Classes I through IV based upon its specific conductance and establishes the groundwater quality standards applicable with respect to each groundwater classification.

Based upon its specific conductance, groundwater in the Big Spring Creek area is considered Class I groundwater[15]. Concentrations of dissolved substances in Class I or II groundwater (or Class III groundwater which is used as a drinking water source) may not exceed the human health standards listed in department Circular DEQ-7. Ground water is measured in dissolved form, according to Circular DEQ-7. Circular DEQ-7 concentrations for the primary contaminant of concern is listed below.

Circular DEQ-7 Human Health Standard (February 2006 edition):

Polychlorinated Biphenyls 0.5 µg/1

For concentrations of parameters for which human health standards are not listed in Circular DEQ-7, ARM 17.30.1006 allows no increase of a parameter to a level that renders the waters harmful, detrimental or injurious to listed beneficial uses.

[15] ARM 17.30.1006 provides that Class I groundwaters are those with specific conductance of less than 1000 microSiemens per centimeter at 25B C; Class II groundwaters: 1000 to 2500; Class III groundwaters: 2500 to 15,000; and Class IV groundwaters: over 15,000.

For Class I and II groundwaters, ARM 17.30.1006 allows no increase of a parameter that causes a violation of the nondegradation provisions of § 75-5-303, MCA. ARM 17.30.1011 also provides that groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality unless degradation may be allowed under the principles established in § 75-5-303, MCA, and the nondegradation rules at ARM 17.30.701 et seq.

An additional concern with respect to ARARs for groundwater is the impact of groundwater upon the surface water. If significant loadings of contaminants from groundwater sources to Big Spring Creek contribute to the inability of the stream to meet its water quality standards, then alternatives to alleviate such groundwater loading must be evaluated and, if appropriate, implemented. Groundwater in certain areas may need to be remediated to levels more stringent than the groundwater classification standards in order to achieve the standards for affected surface water. See Compliance with Federal Water Quality Criteria, OSWER Publication 9234.2-09/FS (June 1990) ("Where the ground water flows naturally into the surface water, the ground-water remediation should be designed so that the receiving surface-water body will be able to meet any ambient water-quality standards (such as State WQSs or FWQC) that may be ARARs for the surface water.").

3.1.2 Air Quality

In addition to the standards identified in the federal action-specific ARARs above, the State of Montana has identified certain air quality standards in the action-specific section of the State ARARs below.

3.2 Montana Location-Specific Requirements

3.2.1 Floodplain and Floodway Management Act, Sections 76-5-401 et seq., and Implementing Regulations (Applicable)

The Floodplain and Floodway Management Act and regulations specify types of uses and structures that are allowed or prohibited in the designated 100-year floodway[16] and floodplain[17]. Since the Big Spring Creek PCB project area lies almost entirely within the 100-year floodplain of the Big Spring Creek, these standards are applicable to all actions contemplated for this site within the floodplain.

1. <u>Allowed Uses</u>: The law recognizes certain uses as allowable in the floodway and a broader range of uses as allowed in the floodplain. Residential use is among the possible allowed uses expressly recognized in both the floodway and floodplain. "Residential uses such as lawns, gardens, parking areas, and play areas," as well as certain agricultural, industrial-commercial, recreational and other uses are permissible within the designated floodway, provided they do not require structures other than portable structures, fill or permanent

[16] The floodway is the channel of a watercourse or drainway and those portions of the floodplain adjoining the channel which are reasonably required to carry and discharge the floodwater of the water course or drainway. ARM 36.15.101(13).

[17] The floodplain is the area adjoining the water course or drainway which would be covered by the floodwater of a base (100-year) flood except for sheet flood areas that receive less than one foot of water per occurrence. The floodplain consists of the floodway and flood fringe. ARM 36.15.101.

storage of materials or equipment. 76-5-401, MCA; ARM 36.15.601. In addition, in the flood fringe (i. e., within the floodplain but outside the floodway), residential, commercial, industrial, and other structures may be permitted subject to certain conditions relating to placement of fill, roads, floodproofing, etc. § 76- 5-402, MCA; ARM 36.15.701. Domestic water supply wells may be permitted, even within the floodway, provided the well casing is watertight to a depth of 25 feet and the well meets certain conditions for floodproofing, sealing, and positive drainage away from the well head. ARM 36.15.602(6).

2. <u>Prohibited Uses</u>: Uses prohibited anywhere in either the floodway or the floodplain are (ARM 36.15.605(2) and 36.15.703):

    a. solid and hazardous waste disposal; and

    b. storage of toxic, flammable, hazardous, or explosive materials.

In the floodway, additional prohibitions apply (Section 76-5-403, MCA), including prohibition of:

a. a building for living purposes or place of assembly or permanent use by human beings;

b. any structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway; and

c. the construction or permanent storage of an object subject to flotation or movement during flood level periods.

3.2.1.1 Applicable Considerations in Use of Floodplain or Floodway

Applicable regulations also specify factors that must be considered in allowing diversions of the stream, changes in place of diversion of the stream, flood control works, new construction or alteration of artificial obstructions, or any other nonconforming use within the floodplain or floodway. Many of these requirements are set forth as factors that must be considered in determining whether a permit can be issued for certain obstructions or uses. While permit requirements are not directly applicable to remedial actions conducted entirely on site, the substantive criteria used to determine whether a proposed obstruction or use is permissible within the floodway or floodplain are applicable standards. Factors which must be considered in addressing any obstruction or use within the floodway or floodplain include:

1. the danger to life and property from backwater or diverted flow caused by the obstruction or use;

2. the danger that the obstruction or use will be swept downstream to the injury of others;

3. the availability of alternate locations;

4. the construction or alteration of the obstruction or use in such a manner as to lessen the danger;

5. the permanence of the obstruction or use; and

6. the anticipated development in the foreseeable future of the area which may be affected by the obstruction or use.

See 76-5-406, MCA; ARM 36.15.216 (substantive provisions only).

Conditions or restrictions that generally apply to specific activities within the floodway or floodplain are:

1. the proposed activity, construction, or use cannot increase the upstream elevation of the 100-year flood a significant amount (one-half foot or as otherwise determined by the permit issuing authority) or significantly increase flood velocities, ARM 36.15.604 (Applicable, substantive provisions only); and

2. the proposed activity, construction, or use must be designed and constructed to minimize potential erosion from a base (100-year) flood, see ARM 36.15.603.

For the substantive conditions and restrictions applicable to specific obstructions or uses, see the following applicable regulations:

- Excavation of material from pits or pools- ARM 36.15.602 (1).

- Water diversions or changes in place of diversion- ARM 36.15.603.

- Flood control works - ARM 36.15.606.

- Roads, streets, highways and rail lines (must be designed to minimize increases in flood heights) - ARM 36.15.701(3) (c).

- Structures and facilities for liquid or solid waste treatment and disposal (must be floodproofed to ensure that no pollutants enter flood waters and may be allowed and approved only in accordance with DEQ regulations, which include certain additional prohibitions on such disposal) - ARM 36.15.701(3) (d).

- Residential structures - ARM 36.15.702(1).

- Commercial or industrial structures - ARM 36.15.702(2).

3.2.1.2 Solid Waste Management Regulations (Applicable)

Regulations promulgated under the Solid Waste Management Act, §§ 75-10-201 et seq., MCA, specify requirements that apply to the location of any solid waste management facility. This would include existing waste disposal areas, newly created debris disposal areas, and the area where wastes will be left in place. Under ARM 17.50.505, a facility for the treatment, storage or disposal of solid wastes:

a. must be located where a sufficient acreage of suitable land is available for solid waste management;

b. may not be located in a 100-year floodplain;

c. may be located only in areas which will prevent the pollution of ground and surface waters and public and private water supply systems;

d. must be located to allow for reclamation and reuse of the land;

e. drainage structures must be installed where necessary to prevent surface runoff from entering waste management areas; and

f. where underlying geological formations contain rock fractures or fissures which may lead to pollution of the ground water or areas in which springs exist that are hydraulically connected to a proposed disposal facility, only Class III disposal facilities may be approved[18].

Even Class III landfills may not be located on the banks of or in a live or intermittent stream or water saturated areas, such as marshes or deep gravel pits which contain exposed ground water. ARM 17.54.505(2)(j).

In addition, § 75-10-212 prohibits dumping or leaving any debris or refuse upon or within 200 yards of any highway, road, street, or alley of the State or other public property, or on privately owned property where hunting, fishing, or other recreation is permitted. However, the restriction relating to privately owned property does not apply to the owner, his agents, or those disposing of debris or refuse with the owner's consent.

3.2.1.3 Natural Streambed and Land Preservation Standards (Relevant and Appropriate)

Sections 87-5-502 and 504, MCA, (substantive provisions only) provide that a state agency or subdivision shall not construct, modify, operate, maintain or fail to maintain any construction project or hydraulic project which may or will obstruct, damage, diminish, destroy, change, or modify, the natural existing shape and form of any stream or its banks or tributaries in a manner that will adversely affect any fish or game habitat. The requirement that any such project must eliminate or diminish any adverse effect on fish or game habitat is applicable to the state in concurring upon any remedial actions to be conducted. The Natural Streambed and Land Preservation Act of 1975, §§ 75-7-101 et seq., MCA, includes substantive requirements and is applicable to private parties as well as government agencies.

While the administrative/procedural requirements including the consent and approval requirement set forth in these statutes and regulations are not ARARs, the party designing and implementing the remedial action for the project should continue to consult with the Montana Department of Fish, Wildlife and Parks and any conservation district or board of county commissioners (or consolidated city/county government) as provided in the referenced statutes, to assist in the evaluation of factors discussed above.

ARM 36.2.410 establishes minimum standards which would be applicable if a remedial action alters or affects a streambed, including any channel change. Projects must be designed and constructed using methods that minimize adverse impacts to the stream (both upstream and downstream) and future disturbances to the stream. All disturbed areas must be managed

[18] Group III consists of primarily inert wastes, including industrial mineral wastes which are essentially inert and non-water soluble and do not contain hazardous waste constituents. ARM 17.50.503(1)(b).

during construction and reclaimed after construction to minimize erosion. Temporary structures used during construction must be designed to handle high flows reasonably anticipated during the construction period. Temporary structures must be completely removed from the stream channel at the conclusion of construction and the area must be restored to a natural or stable condition. Channel alternation must be designed to retain original stream length or otherwise provide hydrologic stability. Streambank vegetation must be protected except where removal of such vegetation is necessary for the completion of the project. When removal of vegetation is necessary, it must be kept to a minimum. Riprap, rock, and other material used in a project must be of adequate size, shape and density and must be properly placed to protect the streambank from erosion. The placement of road fill material in a stream, the placement of debris or other materials in a stream where it can erode or float into the stream, projects that permanently prevent fish migration, operation of construction equipment in a stream, and excavation of streambed gravels are prohibited unless specifically authorized. Such projects must also protect the use of water for any useful or beneficial purpose. See 75-7-102, MCA.

3.2.1.4 Montana Stream Protection Act (Applicable)

The Montana Stream Protection Act, MCA 87-5-501, requires that any agency or subdivision of federal, state, county, or city government proposing a project that may affect the bed or banks of any stream in Montana apply for a Montana Stream Protection Act permit (SPA 124 permit). This applies to activities that are conducted on the streambed or streambanks.

3.3 Montana Action-Specific Requirements

3.3.1 Water Quality Statute and Regulations (Applicable)

Causing of pollution: Section 75-5-605 of the Montana Water Quality Act prohibits the causing of pollution of any state waters. Pollution is defined as contamination or other alteration of physical, chemical, or biological properties of state waters which exceeds that permitted by the water quality standards. The temporary waiver of certain water quality standards and their replacement with temporary standards, as described above, also applies to this requirement. Best Management Practices described in a ROD and further developed during remedial design and/or restoration design would be intended to meet this requirement.

Placement of Wastes: Section 75-5-605, MCA, states that it is unlawful to place or cause to be placed any wastes where they will cause pollution of any state waters. Placement of waste is not prohibited if the authorization for placement contains provisions for review of the placement of materials to ensure it will not cause pollution to state waters.

Nondegradation: Section 75-5-303, MCA, states that existing uses of state waters and the level of water quality necessary to protect the uses must be maintained and protected. Section 75-5-317, MCA, and ARM 17.30.708 provide an exemption from nondegradation requirements which allows changes of existing water quality resulting from an emergency or remedial activity that is designed to protect the public health or the environment and that is approved, authorized, or required by the Department of Environmental Quality. Changes determined to meet these requirements may be considered nonsignificant. In determining that remedial actions are protective of public health and the environment and in approving, authorizing, or requiring such remedial activities, no significant degradation should be approved, considering the criteria for a determination of non-significance set out in 75-5-301(5)(c), which (i) equate significance with the potential for harm to human health, a beneficial use or the environment, (ii) consider both the quantity and strength of the pollutant, (iii) consider the length of time the degradation will occur, and (iv) consider the character of the pollutant so that greater significance is associated with carcinogens and toxins that bioaccumulate or biomagnify and lesser significance is associated with substances that are less harmful or less persistent. Under ARM 17.30.715(1)(b), concentrations of carcinogenic parameters or parameters with a bioconcentration factor greater than 300 cannot exceed the concentration in the receiving water in order for a discharge to be considered nonsignificant and thus exempt from nondegradation requirements under § 75-5-317.

ARM 17.30.705 provides that for all state waters, existing and anticipated uses and the water quality necessary to protect these uses must be maintained and protected.

ARM 17.30.1011 provides that any groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality unless degradation may be allowed under the principles established in § 75-5-303, MCA, and the nondegradation rules at ARM 17.30.701 et seq.

3.3.2 Montana Pollutant Discharge Elimination System (MPDES) - Stormwater and Other Point Sources (Applicable or Relevant and Appropriate)

ARM 17.30.1342 - .1344 set forth the substantive requirements applicable to all MPDES permits. The substantive requirements, including the requirement to properly operate and maintain all facilities and systems of treatment and control are applicable requirements.

Under ARM 17.30.601, ARM 17.30.1101 et seq., and ARM 17.30.1301 et seq., the Montana Department of Environmental Quality has issued general stormwater permits for certain activities. The substantive requirements of the following permits are applicable for the following activities:

- For construction activities: General Permit for Storm Water Discharges Associated with Construction Activity, Permit No. MTR 100000 (April 16, 2007);
- For mining activities: General Permit for Storm Water Discharges Associated with Mining and with Oil and Gas Activities, Permit No. MTR300000 (January 1, 2008);
- For industrial activities: General Permit for Storm Water Discharges Associated with Industrial Activity, Permit No. MTR000000 (October 1, 2006).
- For small municipal separate storm sewer systems (MS4): General Permit for Storm Water Discharges Associated With Small Municipal Separate Storm Sewer Systems (MS4), Permit No. MTR040000 (January 1, 2005).

Generally, the permits listed above require the permittee to implement Best Management Practices (BMP) and to take all reasonable steps to minimize or prevent any discharge which has a reasonable likelihood of adversely affecting human health or the environment. However, if there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with the activity, the substantive standards associated with an individual MPDES permit or alternative general permit may be required.

A related mine reclamation requirement is set out in ARM 17.24.633 (relevant and appropriate), which requires that all surface drainage from disturbed areas that have been graded, seeded or planted must be treated by the best technology currently available (BTCA) before discharge. Sediment control through BTCA practices must be maintained until the disturbed area has been reclaimed, the revegetation requirements have been met, and the area meets state and federal requirements for the receiving stream.

3.3.3 Air Quality

3.3.1.1 Air Quality Regulations (Applicable)

Dust suppression and control of certain substances likely to be released into the air as a result of earth moving, transportation and similar actions related to remedial activity at the Big Spring Creek PCB project area may be necessary to meet air quality requirements. Certain ambient air standards for specific contaminants and particulates are set forth in the federal action-specific section above. Additional air quality regulations under the state Clean Air Act, §§ 75-2-101 et seq., MCA, are discussed below.

ARM 17.8.604 (Applicable) lists certain wastes that may not be disposed of by open burning, including oil or petroleum products, RCRA hazardous wastes, chemicals, and treated lumber and timbers. Any waste which is moved from the premises where it was generated and any trade waste (material resulting from construction or operation of any business, trade, industry or demolition project) may be open burned only in accordance with the substantive requirements of ARM 17.8.611 or 612.

ARM 17.8.308 (Applicable) provide that no person shall cause or authorize the production, handling, transportation or storage of any material, cause or authorize the use of any street, road, or parking lot, or operate a construction site or demolition project, unless reasonable precautions to control emissions of airborne particulate matter are taken. Normally, emissions of airborne particulate matter must be controlled so that they do not "exhibit an opacity of twenty percent (20%) or greater averaged over six consecutive minutes." See also ARM 17.8.304 (Applicable).

In addition, state law provides an ambient air quality standard for settled particulate matter. Particulate matter concentrations in the ambient air shall not exceed the following 30-day average: 10 grams per square meter. ARM 17.8.220 (Applicable). Whenever this standard is exceeded, the activity resulting in such exceedance shall be suspended until such time as conditions improve.

ARM 17.24.761 (Relevant and Appropriate) specifies a range of measures for controlling fugitive dust emissions during mining and reclamation activities. Some of these measures could be considered relevant and appropriate to control fugitive dust emissions in connection with excavation, earth moving and transportation activities conducted as part of the remedy at the site. Such measures include, for example, paving, watering, chemically stabilizing, or frequently compacting and scraping roads, promptly removing rock, soil or other dust-forming debris from roads, restricting vehicle speeds, revegetating, mulching, or otherwise stabilizing the surface of areas adjoining roads, restricting unauthorized-vehicle travel, minimizing the area of disturbed land, and promptly revegetating regraded lands.

3.3.4 Solid Waste Management Regulations (Applicable)

As noted above, the Solid Waste Management Regulations are applicable to the disposal or active management of the sediment, construction debris, and similar wastes within the Big Spring Creek PCB project area. Action-specific solid waste regulations are discussed below:

ARM 17.50.505(2) specifies standards for solid waste management facilities, including the requirements that:

1. Class II[19] landfills must confine solid waste and leachate to the disposal facility. If there is the potential for leachate[20] migration, it must be demonstrated that leachate will only migrate to underlying formations which have no hydraulic continuity with any state waters;

2. adequate separation of group II wastes from underlying or adjacent water must be provided[21]; and

3. no new disposal units or lateral expansions may be located in wetlands.

ARM 17.50.506 specifies design requirements for landfills[22]. Landfills must either be designed to ensure that MCLs are not exceeded or the landfill must contain a composite liner and leachate collection system which comply with specified criteria.

ARM 17.50.511 sets forth general operational and maintenance and design requirements for solid waste management systems. Specific operational and maintenance requirements specified in ARM 17.50.511[23] that are relevant and appropriate are requirements for run-on and runoff control systems, requirements that sites be fenced to prevent unauthorized access, and prohibitions of point source and nonpoint source discharges which would violate Clean Water Act requirements.

ARM 17.50.523 specifies that solid waste must be transported in such a manner as to prevent its discharge, dumping, spilling or leaking from the transport vehicle.

ARM 17.50.530 sets forth the closure[24] requirements for landfills. Class II landfills must meet the following criteria:

1. install a cover that is designed to minimize infiltration and erosion.

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[19] Generally Class II landfills are licensed to receive Group II and Group III waste, but not regulated hazardous waste. Class III landfills may only receive Group III waste. Class IV landfills may receive Group III or IV waste.

[20] Leachate is defined as a liquid which has contacted passed through, or emerged from solid waste and contains soluble, suspended, or miscible materials removed from the waste. ARM 17.50.502(29).

[21] The extent of separation shall be established on a case-by-case basis, considering terrain and the type of underlying soil formations, and facility design. The Waste Management Section of DEQ has generally construed this to require a 10 to 20 foot separation from groundwater.

[22] A landfill is defined as an area of land or an excavation where wastes are placed for permanent disposal, and that is not a land application unit, surface impoundment, injection well, or waste pile. ARM 17.50.502(27).

[23] ARM 17.50.511(1)(j), 17.50.511(l)(k) and 17.50.511(1)(l)

[24] Closure means the process by which the operator closes all or part of the facility.

2. design and construct the final cover system to minimize infiltration through the closed unit by the use of an infiltration layer that contains a minimum 18 inches of earthen material and has a permeability less than or equal to the permeability of any bottom liner, barrier layer, or natural subsoils or a permeability no greater than 1 X 10-5 cm/sec, whichever is less;

3. minimize erosion of the final cover by the use of a seed bed layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth and protecting the infiltration layer from frost effects and rooting damage; and

4. revegetate the final cover with native plant growth within one year of placement of the final cover.

ARM 17.50.530(1)(b) allows an alternative final cover design if the infiltration layer achieves reduction in infiltration at least equivalent to the stated criteria and the erosion layer provides protection equivalent to the stated criteria.

ARM 17.50.531 sets forth post closure care requirements for Class II landfills. Post closure care must be conducted for a period sufficient to protect human health and the environment. Post closure care requires maintenance of the integrity and effectiveness of any final cover, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the cover and comply with the groundwater monitoring requirements found at ARM Title 17, chapter 50, subchapter 7.

Disposal of construction and demolition debris[25] is addressed in regulations for Class III or Class IV landfills. Requirements applicable to the design of Class IV landfills, including plans for construction quality control and construction quality assurance, are found in ARM 17.50.506. Specific operational requirements for Class III and IV facilities are found in ARM 17.50.511, and require, among other things, that conditionally exempt small generator wastes must be removed to the greatest extent practicable and all liquid paints, solvents, glues, resins, dyes, oils, pesticides, and other household hazardous waste must be removed from buildings prior to demolition.

Section 75-10-206, MCA, allows variances to be granted from solid waste regulations if failure to comply with the rules does not result in a danger to public health or safety or compliance with specific rules would produce hardship without producing benefits to the health and safety of the public that outweigh the hardship. In certain circumstances relating to waste nature and volume and the provisions of the Superfund law regarding ongoing maintenance and review, certain of the Solid Waste regulations regarding design of landfills, operational and maintenance requirements, and landfill closure and post-closure care may appropriately be subject to variance for a site. For example, the barrier layer and leachate collection and removal system requirements of ARM 17.50.506 may be subject to variance as long as the design ensures that concentration values listed in Table 1, ARM 17.50.506, will not be exceeded in the uppermost

[25] ARM 17-50-503 provides, “Group III wastes include wood wastes and non-water soluble solids. These wastes are characterized by their general inert nature and low potential for adverse environmental impacts. Examples include, but are not limited to... inert solid waste such as unpainted brick, dirt, rock and concrete ... clean, untreated, unglued wood materials, brush, unpainted or untreated lumber, and vehicle tires; and ... industrial mineral wastes which are essentially inert and non-water soluble and do not contain hazardous waste constituents. ...Group IV wastes include construction and demolition wastes, and asphalt, except regulated hazardous wastes.”

aquifer, measured at the appropriate location. Similarly, the ground water monitoring requirements of ARM 17.50.701 et seq. can be considered and coordinated with any other monitoring requirements under CERCLA.

3.3.5 Reclamation Requirements

3.3.5.1 Noxious Weed Control Act, Section 7-22-2101 et seq., MCA, and ARM 4.5.201 et seq. (Applicable)

These requirements mandate careful weed control planning for identified noxious weeds in projects such as the Big Spring Creek PCB project area.

3.3.5.2 The Strip and Underground Mine Reclamation Act (Relevant and Appropriate)

The Strip and Underground Mine Reclamation Act, §§ 82-4-201 through 254, MCA, technically applies to coal and uranium mining, but that statute and the regulations promulgated under that statue and discussed in this section set out the standards that mine reclamation should attain. Those requirements identified here have been determined to be relevant and appropriate requirements for this action. Section 82-4-231 (Relevant and Appropriate) requires the reclamation and revegetation of the land as rapidly, completely, and effectively as the most modern technology and the most advanced state of the art will allow. In developing a method of operation and plans of backfilling, water control, grading, topsoiling and reclamation, all measures shall be taken to eliminate damages to landowners and members of the public, their real and personal property, public roads, streams, and all other public property from soil erosion, subsidence, landslides, water pollution, and hazards dangerous to life and property. Sections 82-4-231(10)(j) and (10(k)(i) and ARM 17.24.751 (Relevant and Appropriate) provide that reclamation of mine waste materials shall, to the extent possible using the best technology currently available, minimize disturbances and adverse impacts of the operation on fish, wildlife, and related environmental values and achieve enhancement of such resources where practicable, and shall avoid acid or other toxic mine drainage by such measures as preventing or removing water from contact with toxic producing deposits. ARM 17.24.315 sets forth standards for ponds and embankments. Section 82-4-233, MCA, requires vegetation as is necessary to establish a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of land to be affected and capable of self-regeneration and plant succession at least equal in extent of cover to the natural vegetation of the area except that introduced species may be used in the revegetation process where desirable and necessary to achieve the approved post-mining land use plan. ARM 17.24.641 (Relevant and Appropriate) also provides that drainage from acid forming or toxic-forming spoil into ground and surface water must be avoided by preventing water from coming into contact with such spoil. ARM 17.24.505 (Relevant and Appropriate) similarly provides that acid, acid forming, toxic, toxic-forming, or other deleterious materials must not be buried or stored in proximity to a drainage course so as to cause or pose a threat of water pollution.

3.3.5.3 Reclamation Activities - Hydrology Regulations (Relevant and Appropriate)

The hydrology regulations promulgated under the Strip and Underground Mine Reclamation Act, §§ 82-4-201 et seq., MCA, provide detailed guidelines for addressing the hydrologic impacts of mine reclamation activities and earth-moving projects and are relevant and appropriate for addressing these impacts in the Big Spring Creek PCB project area.

ARM 17.24.631 (Relevant and Appropriate) provides that long-term adverse changes in the hydrologic balance from mining and reclamation activities, such as changes in water quality and quantity, and location of surface water drainage channels shall be minimized. Water pollution must be minimized and, where necessary, treatment methods utilized. Diversions of drainage to avoid contamination must be used in preference to the use of water treatment facilities. Other pollution minimization devices must be used if appropriate, including stabilizing disturbed areas through land shaping, diverting runoff, planting quickly germinating and growing stands of temporary vegetation, regulating channel velocity of water, lining drainage channels with rock or vegetation, mulching, and control of acid-forming and toxic-forming waste materials.

ARM 17.24.633 (Relevant and Appropriate) provides water quality performance standards that may be invoked in the event that runoff from the treated areas threatens water quality or sediments in the stream, including the requirement that all surface drainage from a disturbed area must be treated by the best technology currently available (BTCA). Treatment must continue until the area is stabilized.

ARM 17.24.634 (Relevant and Appropriate) provides that, in reclamation of drainages, drainage design must emphasize channel and floodplain dimensions that approximate the pre-mining configuration and that will blend with the undisturbed drainage above and below the area to be reclaimed. The average stream gradient must be maintained with a concave longitudinal profile. This regulation provides specific requirements for designing the reclaimed drainage to:

1. approximate an appropriate geomorphic habit or characteristic pattern;

2. remain in dynamic equilibrium with the system without the use of artificial structural controls;

3. improve unstable pre-mining conditions;

4. provide for floods and for long term stability of the landscape; and

5. establish a pre-mining diversity of aquatic habitats and riparian vegetation.

ARM 17.24.635 through 26.4.637 (Relevant and Appropriate) set forth requirements for temporary and permanent diversions.

ARM 17.24.638 (Relevant and Appropriate) specifies sediment control measures to be implemented during operations.

ARM 17.24.639 (Relevant and Appropriate) sets forth requirements for temporary and permanent sedimentation ponds.

ARM 17.24.640 (Relevant and Appropriate) provides that discharge from sedimentation ponds, permanent and temporary impoundments, and diversions shall be controlled by energy dissipaters, riprap channels, and other devices, where necessary, to reduce erosion, prevent deepening or enlargement of stream channels, and to minimize disturbance of the hydrologic balance.

ARM 17.24.643 (Relevant and Appropriate) requires protection of groundwater resources.

ARM 17.24.645 (Relevant and Appropriate) sets forth requirements for groundwater monitoring.

ARM 17.24.646 (Relevant and Appropriate) sets forth requirements for surface water monitoring.

3.3.5.4 Reclamation and Revegetation Requirements (Relevant and Appropriate)

ARM 17.24.501 (Relevant and Appropriate) gives general backfilling and final grading requirements. Backfill must be placed so as to minimize sedimentation, erosion, and leaching of acid or toxic materials into waters, unless otherwise approved. Final grading must be to the approximate original contour of the land and final slopes must be graded to prevent slope failure, may not exceed the angle of repose, and must achieve a minimum long term static safety factor of 1.3. The disturbed areas must be blended with surrounding and undisturbed ground to provide a smooth transition in topography.

ARM 17.24.519 (Relevant and Appropriate) provides that an operator may be required to monitor settling of regraded areas.

ARM 17.24.702(4), (5), and (6) (Relevant and Appropriate) requires that during the redistributing and stockpiling of soil (for reclamation):

1. regraded areas must be deep-tilled, subsoiled, or otherwise treated to eliminate any possible slippage potential, to relieve compaction, and to promote root penetration and permeability of the underlying layer; this preparation must be done on the contour whenever possible and to a minimum depth of 12 inches;

2. redistribution must be done in a manner that achieves approximate uniform thicknesses consistent with soil resource availability and appropriate for the post-mining vegetation, land uses, contours, and surface water drainage systems; and

3. redistributed soil must be reconditioned by subsoiling or other appropriate methods.

ARM 17.24.703 (Relevant and Appropriate) requires that when using materials other than, or along with, soil for final surfacing in reclamation, the operator must demonstrate that the material (1) is at least as capable as the soil of supporting the approved vegetation and subsequent land use, and (2) the medium must be the best available in the area to support vegetation. Such substitutes must be used in a manner consistent with the requirements for redistribution of soil in ARM 17.24.701 and 702.

ARM 17.24.711 (Relevant and Appropriate) requires that a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of land to be affected shall be established except on road surfaces and below the low-water line of permanent impoundments. See also § 82-4-233, MCA (Relevant and Appropriate). Vegetative cover is considered of the same seasonal variety if it consists of a mixture of species of equal or superior utility when compared with the natural vegetation during each season of the year (See also ARM 17.24.716 and .719 below regarding substitution of introduced species for native species). This requirement may not be appropriate where other cover is more suitable for the particular land use or another cover is requested by the landowner.

ARM 17.24.713 (Relevant and Appropriate) provides that seeding and planting of disturbed areas must be conducted during the first appropriate period for favorable planting after final seedbed preparation.

ARM 17.24.714 (Relevant and Appropriate) requires use of a mulch or cover crop or both until an adequate permanent cover can be established. Use of mulching and temporary cover may be suspended under certain conditions.

ARM 17.24.716 (Relevant and Appropriate) establishes the required method of revegetation, and provides that introduced species may be substituted for native species as part of an approved plan.

ARM 17.24.717 (Relevant and Appropriate) relates to the planting of trees and other woody species if necessary, as provided in § 82-4-233, MCA, to establish a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the affected area and capable of self-regeneration and plan succession at least equal to the natural vegetation of the area, except that introduced species may be used in the revegetation process where desirable and necessary to achieve the approved land use plan.

ARM 17.24.718 (Relevant and Appropriate) requires the use of soil amendments and other means such as irrigation, management, fencing, or other measures, if necessary, to establish a diverse and permanent vegetative cover.

ARM 17.24.721 (Relevant and Appropriate) specifies that rills or gullies in reclaimed areas must be filled, graded or otherwise stabilized and the area reseeded or replanted if the rills and gullies are disrupting the reestablishment of the vegetative cover or causing or contributing to a violation of water quality standards for a receiving stream.

ARM 17.24.723 (Relevant and Appropriate) sets forth requirements for vegetation, soils, wildlife, and other monitoring.

ARM 17.24.724 (Relevant and Appropriate) specifies that revegetation success must be measured against approved unmined reference areas or by comparison with technical standards from historic data. More than one reference area or historic record must be established for vegetation types with significant variation due to a number of factors.

ARM 17.24.726 (Relevant and Appropriate) sets forth vegetation production, cover, diversity, density, and utility requirements.

ARM 17.24.733 (Relevant and Appropriate) sets forth standards for trees, shrubs, and half shrubs.

3.3.6 Natural Streambed and Land Preservation Act (Relevant and Appropriate)

Section 75-7-102, MCA, and ARM 36.2.410 (Applicable), which place limitations on and specify criteria to be considered in approving projects affecting streambeds, would be applicable (substantive provisions only) if alternatives developed alter or affect a streambed.

3.3.7 Montana Stream Protection Act (Applicable)

The Montana Stream Protection Act, MCA 87-5-501, requires that any agency or subdivision of federal, state, county, or city government proposing a project that may affect the bed or banks of any stream in Montana apply for a Montana Stream Protection Act permit (SPA 124 permit). This applies to any action, including the construction of new facilities or the modification, operation, and maintenance of an existing facility, that may affect the natural existing shape and form of any stream or its banks or tributaries.

4.0 TO BE CONSIDERED DOCUMENTS (TBCS)

The use of documents identified as TBCs is addressed in the Introduction, above. A list of TBC documents is included in the Preamble to the NCP, 55 Fed. Reg. 8765 (March 8, 1990). Those documents, plus any additional similar or related documents issued since that time, will be considered by EPA during the conduct of the remedy implementation.

5.0 OTHER LAWS (NON-EXCLUSIVE LIST)

CERCLA defines as ARARs only federal environmental and state environmental and siting laws. Remedial design, implementation, and operation and maintenance must nevertheless comply with all other applicable laws, both state and federal, if the remediation work is done by parties other than the federal government or its contractors.

The following “other laws” are included here to provide a reminder of other legally applicable requirements for actions being considered for the Big Spring Creek PCB project. They do not purport to be an exhaustive list of such legal requirements, but are included because they set out related concerns that must be addressed and, in some cases, may require some advance planning. They are not included as ARARs because they are not “environmental or facility siting laws.” As applicable laws other than ARARs, they are not subject to ARAR waiver provisions.

Section 121(e) of CERCLA exempts removal or remedial actions conducted entirely on-site from federal, state, or local permits. This exemption is not limited to environmental or facility siting laws, but applies to other permit requirements as well.

5.1 Other Federal Laws

5.1.1 Occupational Safety and Health Regulations

The federal Occupational Safety and Health Act regulations found at 29 CFR § 1910 are applicable to worker protection during conduct of all remedial activities.

5.2 Other Montana Laws

5.2.1 Groundwater Act

Section 85-2-505, MCA, (Applicable) precludes the wasting of groundwater. Any well producing waters that contaminate other waters must be plugged or capped, and wells must be constructed and maintained so as to prevent waste, contamination, or pollution of groundwater.

Section 85-2-516, MCA, states that within 60 days after any well is completed, a well log report must be filed by the driller with the DNRC and the appropriate county clerk and recorder.

5.2.2 Public Water Supply Regulations

If remedial action at the site requires any reconstruction or modification of any public water supply line or sewer line, the construction standards specified in ARM 17.38.101 (Applicable) must be observed.

5.2.3 Water Rights

Section 85-2-101, MCA, declares that all waters within the state are the state's property, and may be appropriated for beneficial uses. The wise use of water resources is encouraged for the maximum benefit to the people and with minimum degradation of natural aquatic ecosystems.

Parts 3 and 4 of Title 85, Chapter 2, MCA, set out requirements for obtaining water rights and appropriating and utilizing water. All requirements of these parts are laws which must be complied with in any action using or affecting waters of the state. Some of the specific requirements are set forth below.

Section 85-2-301, MCA, of Montana law provides that a person may only appropriate water for a beneficial use.

Section 85-2-302, MCA, specifies that a person may not appropriate water or commence construction of diversion, impoundment, withdrawal or distribution works therefore except by applying for and receiving a permit from the Montana Department of Natural Resources and Conservation. While the permit itself may not be required under federal law, appropriate notification and submission of an application should be performed and a permit should be applied for in order to establish a priority date in the prior appropriation system.

Section 85-2-306, MCA, specifies the conditions on which groundwater may be appropriated, and, at a minimum, requires notice of completion and appropriation within 60 days of well completion.

Section 85-2-311, MCA, specifies the criteria which must be met in order to appropriate water and includes requirements that:

1. there are unappropriated waters in the source of supply;

2. the proposed use of water is a beneficial use; and

3. the proposed use will not interfere unreasonably with other planned uses or developments.

Section 85-2-402, MCA, specifies that an appropriator may not change an appropriated right except as provided in this section with the approval of the DNRC.

Section 85-2-412, MCA, provides that, where a person has diverted all of the water of a stream by virtue of prior appropriation and there is a surplus of water, over and above what is actually and necessarily used, such surplus must be returned to the stream.

5.2.4 Controlled Ground Water Areas

Pursuant to § 85-2-507, MCA, the Montana Department of Natural Resources and Conservation may grant either a permanent or a temporary controlled ground water area. The maximum allowable time for a temporary area is two years, with a possible two-year extension.

Pursuant to § 85-2-506, MCA, designation of a controlled ground water area may be proposed if: (i) excessive ground water withdrawals would cause contaminant migration; (ii) ground water withdrawals adversely affecting ground water quality within the ground water area are occurring or are likely to occur; or (iii) ground water quality within the ground water area is not suited for a specific beneficial use.

5.2.5 Occupational Health Act, §§ 50-70-101 et seq., MCA

ARM § 17.74.101 addresses occupational noise. In accordance with this section, no worker shall be exposed to noise levels in excess of the levels specified in this regulation. This regulation is applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR 1910.95 applies.

ARM § 17.74.102 addresses occupational air contaminants. The purpose of this rule is to establish maximum threshold limit values for air contaminants under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. In accordance with this rule, no worker shall be exposed to air contaminant levels in excess of the threshold limit values listed in the regulation.

This regulation is applicable only to limited categories of workers and for most workers the similar federal standard in 29 CFR § 1910.1000 applies.

5.2.6 Montana Safety Act

Sections 50-71-201, 202 and 203, MCA, state that every employer must provide and maintain a safe place of employment, provide and require use of safety devices and safeguards, and ensure that operations and processes are reasonably adequate to render the place of employment safe. The employer must also do every other thing reasonably necessary to protect the life and safety of its employees. Employees are prohibited from refusing to use or interfering with the use of safety devices.

5.2.7 Employee and Community Hazardous Chemical Information

Sections 50-78-201, 202, and 204, MCA, state that each employer must post notice of employee rights, maintain at the work place a list of chemical names of each chemical in the work place, and indicate the work area where the chemical is stored or used. Employees must be informed of the chemicals at the work place and trained in the proper handling of the chemicals.

Appendix F

PCB Cleanup Levels at Other Sites

National Results (Source: http://www.cleanuplevel.com)
The database has the following soil cleanup levels nationwide for PCBS+(TOTAL).

State	Site Name	EPA ID	Site Unit	Original Levels	Original Units	Normalized Level	Normalized Unit
MI	Available on paid report	Available on paid report	Available on paid report	1	ppm	1	ppm
MI	Available on paid report	Available on paid report	Available on paid report	21	ppm	21	ppm
GA	Available on paid report	Available on paid report	Available on paid report	1	mg/kg	1	ppm
NY	Available on paid report	Available on paid report	Available on paid report	10	mg/kg	10	ppm
NY	Available on paid report	Available on paid report	Available on paid report	50	mg/kg	50	ppm
ID	Available on paid report	Available on paid report	Available on paid report	1	mg/kg	1	ppm
MI	Available on paid report	Available on paid report	Available on paid report	50	mg/kg	50	ppm
NJ	Available on paid report	Available on paid report	Available on paid report	1	ppm	1	ppm
MA	Available on paid report	Available on paid report	Available on paid report	10	mg/kg	10	ppm
MA	Available on paid report	Available on paid report	Available on paid report	50	mg/kg	50	ppm
WA	Available on paid report	Available on paid report	Available on paid report	12	mg/kg	12	ppm
NY	Available on paid report	Available on paid report	Available on paid report	1	mg/kg	1	ppm
IA	Available on paid report	Available on paid report	Available on paid report	10	mg/kg	10	ppm
NJ	Available on paid report	Available on paid report	Available on paid report	0.49	mg/kg	0.49	ppm
NH	Available on paid report	Available on paid report	Available on paid report	1	mg/kg	1	ppm
NH	Available on paid report	Available on paid report	Available on paid report	1	mg/kg	1	ppm
NH	Available on paid report	Available on paid report	Available on paid report	1	mg/kg	1	ppm
VA	Available on paid report	Available on paid report	Available on paid report	5	ppm	5	ppm
NH	Available on paid report	Available on paid report	Available on paid report	25	mg/kg	25	ppm
NH	Available on paid report	Available on paid report	Available on paid report	100	mg/kg	100	ppm
AK	Available on paid report	Available on paid report	Available on paid report	1	mg/kg	1	ppm
AK	Available on paid report	Available on paid report	Available on paid report	10	mg/kg	10	ppm
AK	Available on paid report	Available on paid report	Available on paid report	500	mg/kg	500	ppm
AZ	Available on paid report	Available on paid report	Available on paid report	2.5	mg/kg	2.5	ppm
AK	Available on paid report	Available on paid report	Available on paid report	1	mg/kg	1	ppm
PA	Available on paid report	Available on paid report	Available on paid report	10	mg/kg	10	ppm
NY	Available on paid report	Available on paid report	Available on paid report	1	mg/kg	1	ppm
NY	Available on paid report	Available on paid report	Available on paid report	10	mg/kg	10	ppm
WA	Available on paid report	Available on paid report	Available on paid report	12	mg/kg	12	ppm
WA	Available on paid report	Available on paid report	Available on paid report	65	mg/kg	65	ppm
AK	Available on paid report	Available on paid report	Available on paid report	1	mg/kg	1	ppm
AK	Available on paid report	Available on paid report	Available on paid report	10	mg/kg	10	ppm
AK	Available on paid report	Available on paid report	Available on paid report	50	mg/kg	50	ppm

National Results (Source: http://www.cleanuplevel.com)

The database has the following soil cleanup levels nationwide for PCBS+(TOTAL).

State	Site Name	EPA ID	Site Unit	Method	Risk	Hazard	Date
MI	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)		n/a	2/10/1998
MI	Available on paid report	Available on paid report	Available on paid report			n/a	2/10/1998
GA	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)		n/a	2/11/1998
NY	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)		n/a	3/23/1998
NY	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)		n/a	3/23/1998
ID	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)		n/a	5/14/1998
MI	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)	1.00E-06	1	6/10/1998
NJ	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)		n/a	9/18/1998
MA	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)	1.00E-06	n/a	9/25/1998
MA	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)	1.00E-06	n/a	9/25/1998
WA	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)		n/a	9/28/1998
NY	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)		n/a	9/29/1998
IA	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)		n/a	9/29/1998
NJ	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)		n/a	9/30/1998
NH	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)	1.00E-06	1	9/30/1998
NH	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)	1.00E-06	1	9/30/1998
NH	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)	1.00E-06	1	9/30/1998
VA	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)		n/a	9/30/1998
NH	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)	1.00E-06	1	9/30/1998
NH	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)	1.00E-06	1	9/30/1998
AK	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)	1.00E-04		11/18/1998
AK	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)	1.00E-04		11/18/1998
AK	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)	1.00E-04		11/18/1998
AZ	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)			5/19/1999
AK	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)		1	3/31/2000
PA	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)	1.40E-05		11/26/2001
NY	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)			3/28/2002
NY	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)			3/28/2002
WA	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)			3/31/2003
WA	Available on paid report	Available on paid report	Available on paid report	Risk (from guidance)			3/31/2003
AK	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)			6/17/2003
AK	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)			6/17/2003
AK	Available on paid report	Available on paid report	Available on paid report	Risk (site specific)			6/17/2003

Appendix G

ProUCL Calculations

ProUCL Output for 95% UCL Calculations by Subreach for Alternative 1 (No Action) (LnROS Method for Nondetect Data)

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	Z:\Projects\A1535\RI\xls\ProUCL\Input\UCL-Herrera-subreaches LnROS-Alt1.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Subreach 2A			
Alt1_2A			
General Statistics			
Number of Valid Observations	70	Number of Distinct Observations	58
Raw Statistics		Log-transformed Statistics	
Minimum	0.567	Minimum of Log Data	-0.567
Maximum	260000	Maximum of Log Data	12.47
Mean	4785	Mean of log Data	4.712
Median	115	SD of log Data	2.433
SD	31091		
Coefficient of Variation	6.498		
Skewness	8.25		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.439	Lilliefors Test Statistic	0.0673
Lilliefors Critical Value	0.106	Lilliefors Critical Value	0.106
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	10980	95% H-UCL	6761
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	5673
95% Adjusted-CLT UCL	14812	97.5% Chebyshev (MVUE) UCL	7329
95% Modified-t UCL	11591	99% Chebyshev (MVUE) UCL	10581
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.197	Data appear Lognormal at 5% Significance Level	
Theta Star	24246		
nu star	27.63		
Approximate Chi Square Value (.05)	16.64	Nonparametric Statistics	
Adjusted Level of Significance	0.0466	95% CLT UCL	10897
Adjusted Chi Square Value	16.46	95% Jackknife UCL	10980
		95% Standard Bootstrap UCL	10771
Anderson-Darling Test Statistic	8.871	95% Bootstrap-t UCL	67619
Anderson-Darling 5% Critical Value	0.913	95% Hall's Bootstrap UCL	44528
Kolmogorov-Smirnov Test Statistic	0.289	95% Percentile Bootstrap UCL	12056
Kolmogorov-Smirnov 5% Critical Value	0.118	95% BCA Bootstrap UCL	18866
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	20983
		97.5% Chebyshev(Mean, Sd) UCL	27992
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	41759
95% Approximate Gamma UCL	7945		
95% Adjusted Gamma UCL	8031		
Potential UCL to Use		Use 95% H-UCL	6761

Subreach 2B			
Alt1_2B			
General Statistics			
Number of Valid Observations	79	Number of Distinct Observations	62
Raw Statistics		Log-transformed Statistics	
Minimum	1.664	Minimum of Log Data	0.509
Maximum	8000	Maximum of Log Data	8.987
Mean	210.8	Mean of log Data	3.73
Median	33.24	SD of log Data	1.507
SD	910.3		
Coefficient of Variation	4.319		
Skewness	8.254		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.409	Lilliefors Test Statistic	0.144
Lilliefors Critical Value	0.0997	Lilliefors Critical Value	0.0997
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	381.3	95% H-UCL	208.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	253.6
95% Adjusted-CLT UCL	480.9	97.5% Chebyshev (MVUE) UCL	308.9
95% Modified-t UCL	397.1	99% Chebyshev (MVUE) UCL	417.4
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.398	Data do not follow a Discernable Distribution (0.05)	
Theta Star	529.3		
nu star	62.92		
Approximate Chi Square Value (.05)	45.67	Nonparametric Statistics	
Adjusted Level of Significance	0.047	95% CLT UCL	379.2
Adjusted Chi Square Value	45.4	95% Jackknife UCL	381.3
		95% Standard Bootstrap UCL	379
Anderson-Darling Test Statistic	7.782	95% Bootstrap-t UCL	916.8
Anderson-Darling 5% Critical Value	0.841	95% Hall's Bootstrap UCL	945.1
Kolmogorov-Smirnov Test Statistic	0.291	95% Percentile Bootstrap UCL	409.1
Kolmogorov-Smirnov 5% Critical Value	0.108	95% BCA Bootstrap UCL	604.6
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	657.2
		97.5% Chebyshev(Mean, Sd) UCL	850.4
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1230
95% Approximate Gamma UCL	290.4		
95% Adjusted Gamma UCL	292.1		
Potential UCL to Use		Use 97.5% Chebyshev (Mean, Sd) UCL	850.4

Subreach 3A			
Alt1_3A			
General Statistics			
Number of Valid Observations	104	Number of Distinct Observations	85
Raw Statistics		Log-transformed Statistics	
Minimum	1.566	Minimum of Log Data	0.449
Maximum	25000	Maximum of Log Data	10.13
Mean	916	Mean of log Data	4.265
Median	44	SD of log Data	2.003
SD	3273		
Coefficient of Variation	3.573		
Skewness	5.383		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.402	Lilliefors Test Statistic	0.113
Lilliefors Critical Value	0.0869	Lilliefors Critical Value	0.0869
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	1449	95% H-UCL	1013
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1179
95% Adjusted-CLT UCL	1625	97.5% Chebyshev (MVUE) UCL	1472
95% Modified-t UCL	1477	99% Chebyshev (MVUE) UCL	2048
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.272	Data do not follow a Discernable Distribution (0.05)	
Theta Star	3362		
nu star	56.67		
Approximate Chi Square Value (.05)	40.36	Nonparametric Statistics	
Adjusted Level of Significance	0.0477	95% CLT UCL	1444
Adjusted Chi Square Value	40.17	95% Jackknife UCL	1449
		95% Standard Bootstrap UCL	1438
Anderson-Darling Test Statistic	12.17	95% Bootstrap-t UCL	1885
Anderson-Darling 5% Critical Value	0.879	95% Hall's Bootstrap UCL	2031
Kolmogorov-Smirnov Test Statistic	0.276	95% Percentile Bootstrap UCL	1505
Kolmogorov-Smirnov 5% Critical Value	0.0965	95% BCA Bootstrap UCL	1651
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	2315
		97.5% Chebyshev(Mean, Sd) UCL	2920
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	4109
95% Approximate Gamma UCL	1286		
95% Adjusted Gamma UCL	1292		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	4109

Subreach 3B			
Alt1_3B			
General Statistics			
Number of Valid Observations	46	Number of Distinct Observations	36
Raw Statistics		Log-transformed Statistics	
Minimum	6.847	Minimum of Log Data	1.924
Maximum	840	Maximum of Log Data	6.733
Mean	103.4	Mean of log Data	3.878
Median	40.46	SD of log Data	1.117
SD	172.9		
Coefficient of Variation	1.673		
Skewness	2.875		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.553	Shapiro Wilk Test Statistic	0.919
Shapiro Wilk Critical Value	0.945	Shapiro Wilk Critical Value	0.945
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	146.2	95% H-UCL	135.8
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	164.8
95% Adjusted-CLT UCL	156.8	97.5% Chebyshev (MVUE) UCL	198
95% Modified-t UCL	148	99% Chebyshev (MVUE) UCL	263
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.747	Data do not follow a Discernable Distribution (0.05)	
Theta Star	138.5		
nu star	68.68		
Approximate Chi Square Value (.05)	50.61	Nonparametric Statistics	
Adjusted Level of Significance	0.0448	95% CLT UCL	145.3
Adjusted Chi Square Value	50.1	95% Jackknife UCL	146.2
		95% Standard Bootstrap UCL	144.7
Anderson-Darling Test Statistic	3.612	95% Bootstrap-t UCL	167.8
Anderson-Darling 5% Critical Value	0.789	95% Hall's Bootstrap UCL	156.4
Kolmogorov-Smirnov Test Statistic	0.252	95% Percentile Bootstrap UCL	146
Kolmogorov-Smirnov 5% Critical Value	0.136	95% BCA Bootstrap UCL	157.4
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	214.5
		97.5% Chebyshev(Mean, Sd) UCL	262.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	357
95% Approximate Gamma UCL	140.3		
95% Adjusted Gamma UCL	141.7		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	357

Subreach 4A

Alt1_4A

General Statistics			
Number of Valid Observations	97	Number of Distinct Observations	77
Raw Statistics		Log-transformed Statistics	
Minimum	4.877	Minimum of Log Data	1.584
Maximum	850	Maximum of Log Data	6.745
Mean	52.56	Mean of log Data	3.196
Median	23.26	SD of log Data	0.98
SD	122.8		
Coefficient of Variation	2.338		
Skewness	4.89		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.367	Lilliefors Test Statistic	0.162
Lilliefors Critical Value	0.09	Lilliefors Critical Value	0.09
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	73.27	95% H-UCL	49.16
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	59.46
95% Adjusted-CLT UCL	79.69	97.5% Chebyshev (MVUE) UCL	68.22
95% Modified-t UCL	74.3	99% Chebyshev (MVUE) UCL	85.43
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.761	Data do not follow a Discernable Distribution (0.05)	
Theta Star	69.08		
nu star	147.6		
Approximate Chi Square Value (.05)	120.5	Nonparametric Statistics	
Adjusted Level of Significance	0.0475	95% CLT UCL	73.07
Adjusted Chi Square Value	120.1	95% Jackknife UCL	73.27
		95% Standard Bootstrap UCL	73.29
Anderson-Darling Test Statistic	9.752	95% Bootstrap-t UCL	92.74
Anderson-Darling 5% Critical Value	0.793	95% Hall's Bootstrap UCL	79.09
Kolmogorov-Smirnov Test Statistic	0.253	95% Percentile Bootstrap UCL	73.48
Kolmogorov-Smirnov 5% Critical Value	0.0943	95% BCA Bootstrap UCL	83.46
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	106.9
		97.5% Chebyshev(Mean, Sd) UCL	130.5
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	176.7
95% Approximate Gamma UCL	64.36		
95% Adjusted Gamma UCL	64.56		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	106.9

Subreach 4B			
Alt1_4B			
General Statistics			
Number of Valid Observations	53	Number of Distinct Observations	45
Raw Statistics		Log-transformed Statistics	
Minimum	20.78	Minimum of Log Data	3.034
Maximum	1100	Maximum of Log Data	7.003
Mean	78.61	Mean of log Data	3.833
Median	38.47	SD of log Data	0.785
SD	159.7		
Coefficient of Variation	2.031		
Skewness	5.478		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.415	Lilliefors Test Statistic	0.239
Lilliefors Critical Value	0.122	Lilliefors Critical Value	0.122
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	115.3	95% H-UCL	78.93
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	95.13
95% Adjusted-CLT UCL	132.3	97.5% Chebyshev (MVUE) UCL	109.3
95% Modified-t UCL	118.1	99% Chebyshev (MVUE) UCL	137.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.028	Data do not follow a Discernable Distribution (0.05)	
Theta Star	76.47		
nu star	109		
Approximate Chi Square Value (.05)	85.87	Nonparametric Statistics	
Adjusted Level of Significance	0.0455	95% CLT UCL	114.7
Adjusted Chi Square Value	85.3	95% Jackknife UCL	115.3
		95% Standard Bootstrap UCL	114.1
Anderson-Darling Test Statistic	7.277	95% Bootstrap-t UCL	175.1
Anderson-Darling 5% Critical Value	0.778	95% Hall's Bootstrap UCL	225.5
Kolmogorov-Smirnov Test Statistic	0.344	95% Percentile Bootstrap UCL	120
Kolmogorov-Smirnov 5% Critical Value	0.125	95% BCA Bootstrap UCL	144.6
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	174.2
		97.5% Chebyshev(Mean, Sd) UCL	215.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	296.8
95% Approximate Gamma UCL	99.76		
95% Adjusted Gamma UCL	100.4		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	174.2

ProUCL Output for 95% UCL Calculations by Subreach for Alternatives 2A, 3A, and 4A with 69 µg/kg Residual PCB Concentration (LnROS Method for Nondetect Data)

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	Z:\Projects\A1535\FS\xls\ProUCL\Input\UCL-Herrera-subreaches LnROS-A69residual.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Subreach 2A			
69_2A			
General Statistics			
Number of Valid Observations	70	Number of Distinct Observations	27
Raw Statistics		Log-transformed Statistics	
Minimum	1.849	Minimum of Log Data	0.615
Maximum	970	Maximum of Log Data	6.877
Mean	117.5	Mean of log Data	4.043
Median	69	SD of log Data	1.215
SD	194.5		
Coefficient of Variation	1.656		
Skewness	3.353		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.413	Lilliefors Test Statistic	0.263
Lilliefors Critical Value	0.106	Lilliefors Critical Value	0.106
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	156.2	95% H-UCL	178.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	210.8
95% Adjusted-CLT UCL	165.7	97.5% Chebyshev (MVUE) UCL	251.2
95% Modified-t UCL	157.8	99% Chebyshev (MVUE) UCL	330.8
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.792	Data do not follow a Discernable Distribution (0.05)	
Theta Star	148.3		
nu star	110.9		
Approximate Chi Square Value (.05)	87.62	Nonparametric Statistics	
Adjusted Level of Significance	0.0466	95% CLT UCL	155.7
Adjusted Chi Square Value	87.19	95% Jackknife UCL	156.2
		95% Standard Bootstrap UCL	154.8
Anderson-Darling Test Statistic	5.783	95% Bootstrap-t UCL	173.6
Anderson-Darling 5% Critical Value	0.789	95% Hall's Bootstrap UCL	162.1
Kolmogorov-Smirnov Test Statistic	0.337	95% Percentile Bootstrap UCL	156.7
Kolmogorov-Smirnov 5% Critical Value	0.11	95% BCA Bootstrap UCL	167
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	218.8
		97.5% Chebyshev(Mean, Sd) UCL	262.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	348.8
95% Approximate Gamma UCL	148.7		
95% Adjusted Gamma UCL	149.5		
Potential UCL to Use		Use 97.5% Chebyshev (Mean, Sd) UCL	262.7

Subreach 2B			
69_2B			
General Statistics			
Number of Valid Observations	79	Number of Distinct Observations	31
Raw Statistics		Log-transformed Statistics	
Minimum	3.893	Minimum of Log Data	1.359
Maximum	8000	Maximum of Log Data	8.987
Mean	174.3	Mean of log Data	4.017
Median	69	SD of log Data	0.954
SD	898.8		
Coefficient of Variation	5.157		
Skewness	8.688		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.473	Lilliefors Test Statistic	0.334
Lilliefors Critical Value	0.0997	Lilliefors Critical Value	0.0997
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	342.6	95% H-UCL	111
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	134.7
95% Adjusted-CLT UCL	446.2	97.5% Chebyshev (MVUE) UCL	155.4
95% Modified-t UCL	359.1	99% Chebyshev (MVUE) UCL	196.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.535	Data do not follow a Discernable Distribution (0.05)	
Theta Star	325.5		
nu star	84.6		
Approximate Chi Square Value (.05)	64.4	Nonparametric Statistics	
Adjusted Level of Significance	0.047	95% CLT UCL	340.6
Adjusted Chi Square Value	64.07	95% Jackknife UCL	342.6
		95% Standard Bootstrap UCL	340.9
Anderson-Darling Test Statistic	16.45	95% Bootstrap-t UCL	2569
Anderson-Darling 5% Critical Value	0.814	95% Hall's Bootstrap UCL	1553
Kolmogorov-Smirnov Test Statistic	0.472	95% Percentile Bootstrap UCL	371.7
Kolmogorov-Smirnov 5% Critical Value	0.106	95% BCA Bootstrap UCL	486.1
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	615.1
		97.5% Chebyshev(Mean, Sd) UCL	805.8
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1180
95% Approximate Gamma UCL	229		
95% Adjusted Gamma UCL	230.1		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	615.1

Subreach 3A			
69_3A			
General Statistics			
Number of Valid Observations	104	Number of Distinct Observations	45
Raw Statistics		Log-transformed Statistics	
Minimum	1.566	Minimum of Log Data	0.449
Maximum	9400	Maximum of Log Data	9.148
Mean	219.5	Mean of log Data	3.851
Median	69	SD of log Data	1.239
SD	1132		
Coefficient of Variation	5.156		
Skewness	7.314		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.48	Lilliefors Test Statistic	0.256
Lilliefors Critical Value	0.0869	Lilliefors Critical Value	0.0869
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	403.7	95% H-UCL	136.4
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	168.3
95% Adjusted-CLT UCL	487.1	97.5% Chebyshev (MVUE) UCL	197.9
95% Modified-t UCL	417	99% Chebyshev (MVUE) UCL	255.9
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.418	Data do not follow a Discernable Distribution (0.05)	
Theta Star	525.8		
nu star	86.84		
Approximate Chi Square Value (.05)	66.36	Nonparametric Statistics	
Adjusted Level of Significance	0.0477	95% CLT UCL	402.1
Adjusted Chi Square Value	66.11	95% Jackknife UCL	403.7
		95% Standard Bootstrap UCL	401.8
Anderson-Darling Test Statistic	18.64	95% Bootstrap-t UCL	4250
Anderson-Darling 5% Critical Value	0.837	95% Hall's Bootstrap UCL	2049
Kolmogorov-Smirnov Test Statistic	0.403	95% Percentile Bootstrap UCL	416.4
Kolmogorov-Smirnov 5% Critical Value	0.0945	95% BCA Bootstrap UCL	552.6
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	703.3
		97.5% Chebyshev(Mean, Sd) UCL	912.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1324
95% Approximate Gamma UCL	287.3		
95% Adjusted Gamma UCL	288.4		
Potential UCL to Use		Use 97.5% Chebyshev (Mean, Sd) UCL	912.7

Subreach 3B			
69_3B			
General Statistics			
Number of Valid Observations	46	Number of Distinct Observations	18
Raw Statistics		Log-transformed Statistics	
Minimum	13.87	Minimum of Log Data	2.63
Maximum	840	Maximum of Log Data	6.733
Mean	76.01	Mean of log Data	4.055
Median	69	SD of log Data	0.602
SD	117		
Coefficient of Variation	1.54		
Skewness	6.443		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.278	Shapiro Wilk Test Statistic	0.75
Shapiro Wilk Critical Value	0.945	Shapiro Wilk Critical Value	0.945
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	105	95% H-UCL	82.37
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	97.25
95% Adjusted-CLT UCL	121.9	97.5% Chebyshev (MVUE) UCL	109.6
95% Modified-t UCL	107.7	99% Chebyshev (MVUE) UCL	133.8
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.846	Data do not follow a Discernable Distribution (0.05)	
Theta Star	41.17		
nu star	169.8		
Approximate Chi Square Value (.05)	140.7	Nonparametric Statistics	
Adjusted Level of Significance	0.0448	95% CLT UCL	104.4
Adjusted Chi Square Value	139.9	95% Jackknife UCL	105
		95% Standard Bootstrap UCL	103.4
Anderson-Darling Test Statistic	6.165	95% Bootstrap-t UCL	199.5
Anderson-Darling 5% Critical Value	0.762	95% Hall's Bootstrap UCL	241.5
Kolmogorov-Smirnov Test Statistic	0.391	95% Percentile Bootstrap UCL	109
Kolmogorov-Smirnov 5% Critical Value	0.132	95% BCA Bootstrap UCL	129
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	151.2
		97.5% Chebyshev(Mean, Sd) UCL	183.8
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	247.7
95% Approximate Gamma UCL	91.75		
95% Adjusted Gamma UCL	92.31		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	151.2

Subreach 4A			
69_4A			
General Statistics			
Number of Valid Observations	97	Number of Distinct Observations	42
Raw Statistics		Log-transformed Statistics	
Minimum	4.877	Minimum of Log Data	1.584
Maximum	850	Maximum of Log Data	6.745
Mean	58.12	Mean of log Data	3.691
Median	69	SD of log Data	0.862
SD	86.22		
Coefficient of Variation	1.483		
Skewness	8.221		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.398	Lilliefors Test Statistic	0.313
Lilliefors Critical Value	0.09	Lilliefors Critical Value	0.09
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	72.66	95% H-UCL	69.87
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	83.27
95% Adjusted-CLT UCL	80.33	97.5% Chebyshev (MVUE) UCL	94.28
95% Modified-t UCL	73.88	99% Chebyshev (MVUE) UCL	115.9
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.451	Data do not follow a Discernable Distribution (0.05)	
Theta Star	40.06		
nu star	281.5		
Approximate Chi Square Value (.05)	243.6	Nonparametric Statistics	
Adjusted Level of Significance	0.0475	95% CLT UCL	72.52
Adjusted Chi Square Value	243.1	95% Jackknife UCL	72.66
		95% Standard Bootstrap UCL	72.19
Anderson-Darling Test Statistic	7.058	95% Bootstrap-t UCL	93.12
Anderson-Darling 5% Critical Value	0.771	95% Hall's Bootstrap UCL	132.5
Kolmogorov-Smirnov Test Statistic	0.265	95% Percentile Bootstrap UCL	73.89
Kolmogorov-Smirnov 5% Critical Value	0.0926	95% BCA Bootstrap UCL	90.19
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	96.28
		97.5% Chebyshev(Mean, Sd) UCL	112.8
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	145.2
95% Approximate Gamma UCL	67.16		
95% Adjusted Gamma UCL	67.3		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	96.28

Subreach 4B			
69_4B			
General Statistics			
Number of Valid Observations	53	Number of Distinct Observations	25
Raw Statistics		Log-transformed Statistics	
Minimum	20.78	Minimum of Log Data	3.034
Maximum	379	Maximum of Log Data	5.938
Mean	62.72	Mean of log Data	3.999
Median	69	SD of log Data	0.49
SD	48.91		
Coefficient of Variation	0.78		
Skewness	5.384		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.411	Lilliefors Test Statistic	0.278
Lilliefors Critical Value	0.122	Lilliefors Critical Value	0.122
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	73.98	95% H-UCL	69.8
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	80.2
95% Adjusted-CLT UCL	79.09	97.5% Chebyshev (MVUE) UCL	88.37
95% Modified-t UCL	74.8	99% Chebyshev (MVUE) UCL	104.4
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.525	Data do not follow a Discernable Distribution (0.05)	
Theta Star	17.79		
nu star	373.7		
Approximate Chi Square Value (.05)	329.9	Nonparametric Statistics	
Adjusted Level of Significance	0.0455	95% CLT UCL	73.78
Adjusted Chi Square Value	328.7	95% Jackknife UCL	73.98
		95% Standard Bootstrap UCL	73.87
Anderson-Darling Test Statistic	4.219	95% Bootstrap-t UCL	86.46
Anderson-Darling 5% Critical Value	0.755	95% Hall's Bootstrap UCL	124
Kolmogorov-Smirnov Test Statistic	0.322	95% Percentile Bootstrap UCL	74.63
Kolmogorov-Smirnov 5% Critical Value	0.123	95% BCA Bootstrap UCL	79.76
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	92.01
		97.5% Chebyshev(Mean, Sd) UCL	104.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	129.6
95% Approximate Gamma UCL	71.05		
95% Adjusted Gamma UCL	71.3		
Potential UCL to Use		Use 95% Student's-t UCL	73.98
		or 95% Modified-t UCL	74.8

ProUCL Output for 95% UCL Calculations by Subreach for Alternatives 2A, 3A, and 4A with 0 µg/kg Residual PCB Concentration (LnROS Method for Nondetect Data)

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	Z:\Projects\A1535\FS\xls\ProUCL\Input\UCL-Herrera-subreaches LnROS-A0residual.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Subreach 2A			
A0_2A			
General Statistics			
Number of Valid Observations	70	Number of Distinct Observations	27
Raw Statistics		Log-transformed Statistics	
Minimum	0	Log Statistics Not Avaliable	
Maximum	970		
Mean	82		
Median	0		
SD	206.2		
Coefficient of Variation	2.515		
Skewness	3.258		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.359	Not Available	
Lilliefors Critical Value	0.106		
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	123.1	95% H-UCL	N/A
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	123.1	95% Adjusted-CLT UCL	132.8
		95% Modified-t UCL	124.7
Gamma Distribution Test		Data Distribution	
Gamma Statistics Not Available		Data do not follow a Discernable Distribution (0.05)	
Potential UCL to Use			
Use 95% Chebyshev (Mean, Sd) UCL	189.4	95% CLT UCL	122.5
		95% Jackknife UCL	123.1
		95% Standard Bootstrap UCL	122.1
		95% Bootstrap-t UCL	141
		95% Hall's Bootstrap UCL	126.8
		95% Percentile Bootstrap UCL	123.4
		95% BCA Bootstrap UCL	134.5
		95% Chebyshev(Mean, Sd) UCL	189.4
		97.5% Chebyshev(Mean, Sd) UCL	235.9
		99% Chebyshev(Mean, Sd) UCL	327.3

Subreach 2B			
A0_2B			
General Statistics			
Number of Valid Observations	79	Number of Distinct Observations	31
Raw Statistics		Log-transformed Statistics	
Minimum	0	Log Statistics Not Avaliable	
Maximum	8000		
Mean	135.9		
Median	0		
SD	904		
Coefficient of Variation	6.654		
Skewness	8.667		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.457	Not Available	
Lilliefors Critical Value	0.0997		
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	305.2	95% H-UCL	N/A
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	305.2	95% Adjusted-CLT UCL	409.1
		95% Modified-t UCL	321.7
Gamma Distribution Test		Data Distribution	
Gamma Statistics Not Available		Data do not follow a Discernable Distribution (0.05)	
Potential UCL to Use			
Use 95% Chebyshev (Mean, Sd) UCL	579.2	95% CLT UCL	303.1
		95% Jackknife UCL	305.2
		95% Standard Bootstrap UCL	300.5
		95% Bootstrap-t UCL	2064
		95% Hall's Bootstrap UCL	1536
		95% Percentile Bootstrap UCL	330.4
		95% BCA Bootstrap UCL	447
		95% Chebyshev(Mean, Sd) UCL	579.2
		97.5% Chebyshev(Mean, Sd) UCL	771
		99% Chebyshev(Mean, Sd) UCL	1148

Subreach 3A			
A0_3A			
General Statistics			
Number of Valid Observations	104	Number of Distinct Observations	45
Raw Statistics		Log-transformed Statistics	
Minimum	0	Log Statistics Not Avaliable	
Maximum	9400		
Mean	185		
Median	0.783		
SD	1137		
Coefficient of Variation	6.146		
Skewness	7.305		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.468	Not Available	
Lilliefors Critical Value	0.0869		
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	370.1	95% H-UCL	N/A
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	370.1	95% Adjusted-CLT UCL	453.8
		95% Modified-t UCL	383.4
Gamma Distribution Test		Data Distribution	
Gamma Statistics Not Available		Data do not follow a Discernable Distribution (0.05)	
Potential UCL to Use			
Use 95% Chebyshev (Mean, Sd) UCL	671	95% CLT UCL	368.4
		95% Jackknife UCL	370.1
		95% Standard Bootstrap UCL	371.1
		95% Bootstrap-t UCL	3778
		95% Hall's Bootstrap UCL	2240
		95% Percentile Bootstrap UCL	383.9
		95% BCA Bootstrap UCL	508.9
		95% Chebyshev(Mean, Sd) UCL	671
		97.5% Chebyshev(Mean, Sd) UCL	881.3
		99% Chebyshev(Mean, Sd) UCL	1294

Subreach 3B			
A0_3B			
General Statistics			
Number of Valid Observations	46	Number of Distinct Observations	18
Raw Statistics		Log-transformed Statistics	
Minimum	0	Log Statistics Not Avaliable	
Maximum	840		
Mean	37.01		
Median	0		
SD	124.3		
Coefficient of Variation	3.359		
Skewness	6.256		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.299	Not Available	
Shapiro Wilk Critical Value	0.945		
Data not Normal at 5% Significance Level			
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	67.79	95% H-UCL	N/A
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	67.79	95% Adjusted-CLT UCL	85.23
		95% Modified-t UCL	70.61
Gamma Distribution Test		Data Distribution	
Gamma Statistics Not Available		Data do not follow a Discernable Distribution (0.05)	
Potential UCL to Use			
Use 95% Chebyshev (Mean, Sd) UCL	116.9	95% CLT UCL	67.16
		95% Jackknife UCL	67.79
		95% Standard Bootstrap UCL	66.57
		95% Bootstrap-t UCL	155.7
		95% Hall's Bootstrap UCL	181.6
		95% Percentile Bootstrap UCL	71.04
		95% BCA Bootstrap UCL	93.22
		95% Chebyshev(Mean, Sd) UCL	116.9
		97.5% Chebyshev(Mean, Sd) UCL	151.5
		99% Chebyshev(Mean, Sd) UCL	219.4

Subreach 4A			
A0_4A			
General Statistics			
Number of Valid Observations	97	Number of Distinct Observations	42
Raw Statistics		Log-transformed Statistics	
Minimum	0	Log Statistics Not Avaliable	
Maximum	850		
Mean	21.84		
Median	0		
SD	88.52		
Coefficient of Variation	4.052		
Skewness	8.769		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.403	Not Available	
Lilliefors Critical Value	0.09		
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	36.77	95% H-UCL	N/A
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	36.77	95% Adjusted-CLT UCL	45.18
		95% Modified-t UCL	38.11
Gamma Distribution Test		Data Distribution	
Gamma Statistics Not Available		Data do not follow a Discernable Distribution (0.05)	
Potential UCL to Use			
Use 95% Chebyshev (Mean, Sd) UCL	61.02	95% CLT UCL	36.63
		95% Jackknife UCL	36.77
		95% Standard Bootstrap UCL	36.65
		95% Bootstrap-t UCL	75.02
		95% Hall's Bootstrap UCL	90.23
		95% Percentile Bootstrap UCL	38.8
		95% BCA Bootstrap UCL	51.29
		95% Chebyshev(Mean, Sd) UCL	61.02
		97.5% Chebyshev(Mean, Sd) UCL	77.97
		99% Chebyshev(Mean, Sd) UCL	111.3

Subreach 4B			
A0_4B			
General Statistics			
Number of Valid Observations	53	Number of Distinct Observations	25
Raw Statistics		Log-transformed Statistics	
Minimum	0	Log Statistics Not Avaliable	
Maximum	379		
Mean	26.27		
Median	0		
SD	56		
Coefficient of Variation	2.131		
Skewness	5.123		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.319	Not Available	
Lilliefors Critical Value	0.122		
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	39.15	95% H-UCL	N/A
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	39.15	95% Adjusted-CLT UCL	44.71
		95% Modified-t UCL	40.05
Gamma Distribution Test		Data Distribution	
Gamma Statistics Not Available		Data do not follow a Discernable Distribution (0.05)	
Potential UCL to Use			
Use 95% Chebyshev (Mean, Sd) UCL	59.8	95% CLT UCL	38.92
		95% Jackknife UCL	39.15
		95% Standard Bootstrap UCL	39.18
		95% Bootstrap-t UCL	53.77
		95% Hall's Bootstrap UCL	95.2
		95% Percentile Bootstrap UCL	39.91
		95% BCA Bootstrap UCL	46.67
		95% Chebyshev(Mean, Sd) UCL	59.8
		97.5% Chebyshev(Mean, Sd) UCL	74.31
		99% Chebyshev(Mean, Sd) UCL	102.8

ProUCL Output for 95% UCL Calculations by Subreach for Alternatives 2A, 3A, and 4A with 100 µg/kg Residual PCB Concentration (LnROS Method for Nondetect Data)

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	Z:\Projects\A1535\FS\xls\ProUCL\Input\UCL-Herrera-subreaches LnROS-A100residual.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Subreach 2A			
A100_2A			
General Statistics			
Number of Valid Observations	70	Number of Distinct Observations	27
Raw Statistics		Log-transformed Statistics	
Minimum	1.849	Minimum of Log Data	0.615
Maximum	970	Maximum of Log Data	6.877
Mean	133.4	Mean of log Data	4.234
Median	100	SD of log Data	1.259
SD	191.1		
Coefficient of Variation	1.432		
Skewness	3.287		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.384	Lilliefors Test Statistic	0.316
Lilliefors Critical Value	0.106	Lilliefors Critical Value	0.106
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	171.5	95% H-UCL	222.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	274.6
95% Adjusted-CLT UCL	180.6	97.5% Chebyshev (MVUE) UCL	328.8
95% Modified-t UCL	173	99% Chebyshev (MVUE) UCL	435.2
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.859	Data do not follow a Discernable Distribution (0.05)	
Theta Star	155.3		
nu star	120.3		
Approximate Chi Square Value (.05)	95.93	Nonparametric Statistics	
Adjusted Level of Significance	0.0466	95% CLT UCL	171
Adjusted Chi Square Value	95.47	95% Jackknife UCL	171.5
		95% Standard Bootstrap UCL	170.9
Anderson-Darling Test Statistic	4.974	95% Bootstrap-t UCL	183.9
Anderson-Darling 5% Critical Value	0.786	95% Hall's Bootstrap UCL	178.8
Kolmogorov-Smirnov Test Statistic	0.272	95% Percentile Bootstrap UCL	172.2
Kolmogorov-Smirnov 5% Critical Value	0.11	95% BCA Bootstrap UCL	182.9
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	233
		97.5% Chebyshev(Mean, Sd) UCL	276.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	360.7
95% Approximate Gamma UCL	167.3		
95% Adjusted Gamma UCL	168.1		
Potential UCL to Use		Use 97.5% Chebyshev (Mean, Sd) UCL	276.1

Subreach 2B			
A100_2B			
General Statistics			
Number of Valid Observations	79	Number of Distinct Observations	31
Raw Statistics		Log-transformed Statistics	
Minimum	3.893	Minimum of Log Data	1.359
Maximum	8000	Maximum of Log Data	8.987
Mean	191.6	Mean of log Data	4.224
Median	100	SD of log Data	1.018
SD	896.9		
Coefficient of Variation	4.682		
Skewness	8.685		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.481	Lilliefors Test Statistic	0.291
Lilliefors Critical Value	0.0997	Lilliefors Critical Value	0.0997
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	359.5	95% H-UCL	148.6
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	181.4
95% Adjusted-CLT UCL	462.9	97.5% Chebyshev (MVUE) UCL	210.8
95% Modified-t UCL	376	99% Chebyshev (MVUE) UCL	268.5
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.585	Data do not follow a Discernable Distribution (0.05)	
Theta Star	327.4		
nu star	92.43		
Approximate Chi Square Value (.05)	71.26	Nonparametric Statistics	
Adjusted Level of Significance	0.047	95% CLT UCL	357.5
Adjusted Chi Square Value	70.91	95% Jackknife UCL	359.5
		95% Standard Bootstrap UCL	362.1
Anderson-Darling Test Statistic	12.97	95% Bootstrap-t UCL	1991
Anderson-Darling 5% Critical Value	0.809	95% Hall's Bootstrap UCL	1161
Kolmogorov-Smirnov Test Statistic	0.438	95% Percentile Bootstrap UCL	390.4
Kolmogorov-Smirnov 5% Critical Value	0.105	95% BCA Bootstrap UCL	506.2
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	631.4
		97.5% Chebyshev(Mean, Sd) UCL	821.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1196
95% Approximate Gamma UCL	248.5		
95% Adjusted Gamma UCL	249.7		
Potential UCL to Use		Use 97.5% Chebyshev (Mean, Sd) UCL	821.7

Subreach 3A			
A100_3A			
General Statistics			
Number of Valid Observations	104	Number of Distinct Observations	44
Raw Statistics		Log-transformed Statistics	
Minimum	1.566	Minimum of Log Data	0.449
Maximum	9400	Maximum of Log Data	9.148
Mean	235	Mean of log Data	4.037
Median	100	SD of log Data	1.309
SD	1130		
Coefficient of Variation	4.808		
Skewness	7.311		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.485	Lilliefors Test Statistic	0.283
Lilliefors Critical Value	0.0869	Lilliefors Critical Value	0.0869
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	418.9	95% H-UCL	184.3
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	228.1
95% Adjusted-CLT UCL	502.1	97.5% Chebyshev (MVUE) UCL	269.9
95% Modified-t UCL	432.2	99% Chebyshev (MVUE) UCL	352.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.447	Data do not follow a Discernable Distribution (0.05)	
Theta Star	526.3		
nu star	92.89		
Approximate Chi Square Value (.05)	71.66	Nonparametric Statistics	
Adjusted Level of Significance	0.0477	95% CLT UCL	417.3
Adjusted Chi Square Value	71.4	95% Jackknife UCL	418.9
		95% Standard Bootstrap UCL	412.2
Anderson-Darling Test Statistic	16.26	95% Bootstrap-t UCL	2553
Anderson-Darling 5% Critical Value	0.83	95% Hall's Bootstrap UCL	2034
Kolmogorov-Smirnov Test Statistic	0.399	95% Percentile Bootstrap UCL	430.1
Kolmogorov-Smirnov 5% Critical Value	0.0941	95% BCA Bootstrap UCL	540
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	718
		97.5% Chebyshev(Mean, Sd) UCL	927
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1337
95% Approximate Gamma UCL	304.6		
95% Adjusted Gamma UCL	305.7		
Potential UCL to Use		Use 97.5% Chebyshev (Mean, Sd) UCL	927

Subreach 3B			
A100_3B			
General Statistics			
Number of Valid Observations	46	Number of Distinct Observations	18
Raw Statistics		Log-transformed Statistics	
Minimum	13.87	Minimum of Log Data	2.63
Maximum	840	Maximum of Log Data	6.733
Mean	93.53	Mean of log Data	4.264
Median	100	SD of log Data	0.688
SD	117		
Coefficient of Variation	1.251		
Skewness	5.982		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.356	Shapiro Wilk Test Statistic	0.805
Shapiro Wilk Critical Value	0.945	Shapiro Wilk Critical Value	0.945
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	122.5	95% H-UCL	110.9
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	132.7
95% Adjusted-CLT UCL	138.2	97.5% Chebyshev (MVUE) UCL	151.4
95% Modified-t UCL	125	99% Chebyshev (MVUE) UCL	188.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.86	Data do not follow a Discernable Distribution (0.05)	
Theta Star	50.27		
nu star	171.2		
Approximate Chi Square Value (.05)	141.9	Nonparametric Statistics	
Adjusted Level of Significance	0.0448	95% CLT UCL	121.9
Adjusted Chi Square Value	141	95% Jackknife UCL	122.5
		95% Standard Bootstrap UCL	121.6
Anderson-Darling Test Statistic	4.398	95% Bootstrap-t UCL	168.4
Anderson-Darling 5% Critical Value	0.761	95% Hall's Bootstrap UCL	240.9
Kolmogorov-Smirnov Test Statistic	0.326	95% Percentile Bootstrap UCL	126.4
Kolmogorov-Smirnov 5% Critical Value	0.132	95% BCA Bootstrap UCL	146.9
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	168.7
		97.5% Chebyshev(Mean, Sd) UCL	201.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	265.2
95% Approximate Gamma UCL	112.8		
95% Adjusted Gamma UCL	113.5		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	168.7

Subreach 4A			
A100_4A			
General Statistics			
Number of Valid Observations	97	Number of Distinct Observations	42
Raw Statistics		Log-transformed Statistics	
Minimum	4.877	Minimum of Log Data	1.584
Maximum	850	Maximum of Log Data	6.745
Mean	74.42	Mean of log Data	3.886
Median	100	SD of log Data	0.996
SD	89.63		
Coefficient of Variation	1.204		
Skewness	6.808		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.357	Lilliefors Test Statistic	0.322
Lilliefors Critical Value	0.09	Lilliefors Critical Value	0.09
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	89.54	95% H-UCL	100.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	121.3
95% Adjusted-CLT UCL	96.11	97.5% Chebyshev (MVUE) UCL	139.5
95% Modified-t UCL	90.59	99% Chebyshev (MVUE) UCL	175.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.288	Data do not follow a Discernable Distribution (0.05)	
Theta Star	57.79		
nu star	249.8		
Approximate Chi Square Value (.05)	214.3	Nonparametric Statistics	
Adjusted Level of Significance	0.0475	95% CLT UCL	89.39
Adjusted Chi Square Value	213.8	95% Jackknife UCL	89.54
		95% Standard Bootstrap UCL	89.07
Anderson-Darling Test Statistic	8.006	95% Bootstrap-t UCL	102.3
Anderson-Darling 5% Critical Value	0.775	95% Hall's Bootstrap UCL	156
Kolmogorov-Smirnov Test Statistic	0.297	95% Percentile Bootstrap UCL	90.6
Kolmogorov-Smirnov 5% Critical Value	0.0929	95% BCA Bootstrap UCL	98.79
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	114.1
		97.5% Chebyshev(Mean, Sd) UCL	131.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	165
95% Approximate Gamma UCL	86.79		
95% Adjusted Gamma UCL	86.99		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	114.1

Subreach 4B			
A100_4B			
General Statistics			
Number of Valid Observations	53	Number of Distinct Observations	25
Raw Statistics		Log-transformed Statistics	
Minimum	20.78	Minimum of Log Data	3.034
Maximum	379	Maximum of Log Data	5.938
Mean	79.1	Mean of log Data	4.195
Median	100	SD of log Data	0.608
SD	53.35		
Coefficient of Variation	0.674		
Skewness	3.352		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.31	Lilliefors Test Statistic	0.316
Lilliefors Critical Value	0.122	Lilliefors Critical Value	0.122
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	91.37	95% H-UCL	94.02
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	110.5
95% Adjusted-CLT UCL	94.76	97.5% Chebyshev (MVUE) UCL	123.9
95% Modified-t UCL	91.94	99% Chebyshev (MVUE) UCL	150.3
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.837	Data do not follow a Discernable Distribution (0.05)	
Theta Star	27.88		
nu star	300.7		
Approximate Chi Square Value (.05)	261.6	Nonparametric Statistics	
Adjusted Level of Significance	0.0455	95% CLT UCL	91.16
Adjusted Chi Square Value	260.5	95% Jackknife UCL	91.37
		95% Standard Bootstrap UCL	91.13
Anderson-Darling Test Statistic	3.92	95% Bootstrap-t UCL	95.14
Anderson-Darling 5% Critical Value	0.757	95% Hall's Bootstrap UCL	150.6
Kolmogorov-Smirnov Test Statistic	0.296	95% Percentile Bootstrap UCL	91.94
Kolmogorov-Smirnov 5% Critical Value	0.123	95% BCA Bootstrap UCL	95.09
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	111
		97.5% Chebyshev(Mean, Sd) UCL	124.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	152
95% Approximate Gamma UCL	90.95		
95% Adjusted Gamma UCL	91.3		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	111

ProUCL Output for 95% UCL Calculations by Subreach for Alternatives 2B, 3B, and 4B with 69 µg/kg Residual PCB Concentration (LnROS Method for Nondetect Data)

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	Z:\Projects\A1535\FS\xls\ProUCL\Input\UCL-Herrera-subreaches LnROS-B69residual.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Subreach 2A			
B69_2A			
General Statistics			
Number of Valid Observations	70	Number of Distinct Observations	27
Raw Statistics		Log-transformed Statistics	
Minimum	1.849	Minimum of Log Data	0.615
Maximum	970	Maximum of Log Data	6.877
Mean	117.5	Mean of log Data	4.043
Median	69	SD of log Data	1.215
SD	194.5		
Coefficient of Variation	1.656		
Skewness	3.353		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.413	Lilliefors Test Statistic	0.263
Lilliefors Critical Value	0.106	Lilliefors Critical Value	0.106
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	156.2	95% H-UCL	178.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	210.8
95% Adjusted-CLT UCL	165.7	97.5% Chebyshev (MVUE) UCL	251.2
95% Modified-t UCL	157.8	99% Chebyshev (MVUE) UCL	330.8
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.792	Data do not follow a Discernable Distribution (0.05)	
Theta Star	148.3		
nu star	110.9		
Approximate Chi Square Value (.05)	87.62	Nonparametric Statistics	
Adjusted Level of Significance	0.0466	95% CLT UCL	155.7
Adjusted Chi Square Value	87.19	95% Jackknife UCL	156.2
		95% Standard Bootstrap UCL	155.2
Anderson-Darling Test Statistic	5.783	95% Bootstrap-t UCL	176.3
Anderson-Darling 5% Critical Value	0.789	95% Hall's Bootstrap UCL	160.4
Kolmogorov-Smirnov Test Statistic	0.337	95% Percentile Bootstrap UCL	157.5
Kolmogorov-Smirnov 5% Critical Value	0.11	95% BCA Bootstrap UCL	168.7
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	218.8
		97.5% Chebyshev(Mean, Sd) UCL	262.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	348.8
95% Approximate Gamma UCL	148.7		
95% Adjusted Gamma UCL	149.5		
Potential UCL to Use		Use 97.5% Chebyshev (Mean, Sd) UCL	262.7

Subreach 2B			
B69_2B			
General Statistics			
Number of Valid Observations	79	Number of Distinct Observations	31
Raw Statistics		Log-transformed Statistics	
Minimum	3.893	Minimum of Log Data	1.359
Maximum	8000	Maximum of Log Data	8.987
Mean	174.3	Mean of log Data	4.017
Median	69	SD of log Data	0.954
SD	898.8		
Coefficient of Variation	5.157		
Skewness	8.688		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.473	Lilliefors Test Statistic	0.334
Lilliefors Critical Value	0.0997	Lilliefors Critical Value	0.0997
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	342.6	95% H-UCL	111
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	134.7
95% Adjusted-CLT UCL	446.2	97.5% Chebyshev (MVUE) UCL	155.4
95% Modified-t UCL	359.1	99% Chebyshev (MVUE) UCL	196.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.535	Data do not follow a Discernable Distribution (0.05)	
Theta Star	325.5		
nu star	84.6		
Approximate Chi Square Value (.05)	64.4	Nonparametric Statistics	
Adjusted Level of Significance	0.047	95% CLT UCL	340.6
Adjusted Chi Square Value	64.07	95% Jackknife UCL	342.6
		95% Standard Bootstrap UCL	339.3
Anderson-Darling Test Statistic	16.45	95% Bootstrap-t UCL	2573
Anderson-Darling 5% Critical Value	0.814	95% Hall's Bootstrap UCL	1524
Kolmogorov-Smirnov Test Statistic	0.472	95% Percentile Bootstrap UCL	373.9
Kolmogorov-Smirnov 5% Critical Value	0.106	95% BCA Bootstrap UCL	562.4
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	615.1
		97.5% Chebyshev(Mean, Sd) UCL	805.8
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1180
95% Approximate Gamma UCL	229		
95% Adjusted Gamma UCL	230.1		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	615.1

Subreach 3A			
B69_3A			
General Statistics			
Number of Valid Observations	104	Number of Distinct Observations	45
Raw Statistics		Log-transformed Statistics	
Minimum	1.566	Minimum of Log Data	0.449
Maximum	9400	Maximum of Log Data	9.148
Mean	219.5	Mean of log Data	3.851
Median	69	SD of log Data	1.239
SD	1132		
Coefficient of Variation	5.156		
Skewness	7.314		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.48	Lilliefors Test Statistic	0.256
Lilliefors Critical Value	0.0869	Lilliefors Critical Value	0.0869
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	403.7	95% H-UCL	136.4
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	168.3
95% Adjusted-CLT UCL	487.1	97.5% Chebyshev (MVUE) UCL	197.9
95% Modified-t UCL	417	99% Chebyshev (MVUE) UCL	255.9
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.418	Data do not follow a Discernable Distribution (0.05)	
Theta Star	525.8		
nu star	86.84		
Approximate Chi Square Value (.05)	66.36	Nonparametric Statistics	
Adjusted Level of Significance	0.0477	95% CLT UCL	402.1
Adjusted Chi Square Value	66.11	95% Jackknife UCL	403.7
		95% Standard Bootstrap UCL	400.1
Anderson-Darling Test Statistic	18.64	95% Bootstrap-t UCL	4346
Anderson-Darling 5% Critical Value	0.837	95% Hall's Bootstrap UCL	2035
Kolmogorov-Smirnov Test Statistic	0.403	95% Percentile Bootstrap UCL	433.2
Kolmogorov-Smirnov 5% Critical Value	0.0945	95% BCA Bootstrap UCL	517.2
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	703.3
		97.5% Chebyshev(Mean, Sd) UCL	912.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1324
95% Approximate Gamma UCL	287.3		
95% Adjusted Gamma UCL	288.4		
Potential UCL to Use		Use 97.5% Chebyshev (Mean, Sd) UCL	912.7

Subreach 3B			
B_3B			
General Statistics			
Number of Valid Observations	46	Number of Distinct Observations	36
Raw Statistics		Log-transformed Statistics	
Minimum	6.847	Minimum of Log Data	1.924
Maximum	840	Maximum of Log Data	6.733
Mean	103.4	Mean of log Data	3.878
Median	40.46	SD of log Data	1.117
SD	172.9		
Coefficient of Variation	1.673		
Skewness	2.875		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.553	Shapiro Wilk Test Statistic	0.919
Shapiro Wilk Critical Value	0.945	Shapiro Wilk Critical Value	0.945
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	146.2	95% H-UCL	135.8
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	164.8
95% Adjusted-CLT UCL	156.8	97.5% Chebyshev (MVUE) UCL	198
95% Modified-t UCL	148	99% Chebyshev (MVUE) UCL	263
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.747	Data do not follow a Discernable Distribution (0.05)	
Theta Star	138.5		
nu star	68.68		
Approximate Chi Square Value (.05)	50.61	Nonparametric Statistics	
Adjusted Level of Significance	0.0448	95% CLT UCL	145.3
Adjusted Chi Square Value	50.1	95% Jackknife UCL	146.2
		95% Standard Bootstrap UCL	145.3
Anderson-Darling Test Statistic	3.612	95% Bootstrap-t UCL	166.9
Anderson-Darling 5% Critical Value	0.789	95% Hall's Bootstrap UCL	158.1
Kolmogorov-Smirnov Test Statistic	0.252	95% Percentile Bootstrap UCL	147.7
Kolmogorov-Smirnov 5% Critical Value	0.136	95% BCA Bootstrap UCL	155.8
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	214.5
		97.5% Chebyshev(Mean, Sd) UCL	262.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	357
95% Approximate Gamma UCL	140.3		
95% Adjusted Gamma UCL	141.7		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	357

Subreach 4A			
B_4A			
General Statistics			
Number of Valid Observations	97	Number of Distinct Observations	77
Raw Statistics		Log-transformed Statistics	
Minimum	4.877	Minimum of Log Data	1.584
Maximum	850	Maximum of Log Data	6.745
Mean	52.56	Mean of log Data	3.196
Median	23.26	SD of log Data	0.98
SD	122.8		
Coefficient of Variation	2.338		
Skewness	4.89		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.367	Lilliefors Test Statistic	0.162
Lilliefors Critical Value	0.09	Lilliefors Critical Value	0.09
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	73.27	95% H-UCL	49.16
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	59.46
95% Adjusted-CLT UCL	79.69	97.5% Chebyshev (MVUE) UCL	68.22
95% Modified-t UCL	74.3	99% Chebyshev (MVUE) UCL	85.43
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.761	Data do not follow a Discernable Distribution (0.05)	
Theta Star	69.08		
nu star	147.6		
Approximate Chi Square Value (.05)	120.5	Nonparametric Statistics	
Adjusted Level of Significance	0.0475	95% CLT UCL	73.07
Adjusted Chi Square Value	120.1	95% Jackknife UCL	73.27
		95% Standard Bootstrap UCL	72.94
Anderson-Darling Test Statistic	9.752	95% Bootstrap-t UCL	92.25
Anderson-Darling 5% Critical Value	0.793	95% Hall's Bootstrap UCL	77.79
Kolmogorov-Smirnov Test Statistic	0.253	95% Percentile Bootstrap UCL	73.34
Kolmogorov-Smirnov 5% Critical Value	0.0943	95% BCA Bootstrap UCL	83.29
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	106.9
		97.5% Chebyshev(Mean, Sd) UCL	130.5
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	176.7
95% Approximate Gamma UCL	64.36		
95% Adjusted Gamma UCL	64.56		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	106.9

Subreach 4B			
B_4B			
General Statistics			
Number of Valid Observations	53	Number of Distinct Observations	45
Raw Statistics		Log-transformed Statistics	
Minimum	20.78	Minimum of Log Data	3.034
Maximum	1100	Maximum of Log Data	7.003
Mean	78.61	Mean of log Data	3.833
Median	38.47	SD of log Data	0.785
SD	159.7		
Coefficient of Variation	2.031		
Skewness	5.478		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.415	Lilliefors Test Statistic	0.239
Lilliefors Critical Value	0.122	Lilliefors Critical Value	0.122
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	115.3	95% H-UCL	78.93
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	95.13
95% Adjusted-CLT UCL	132.3	97.5% Chebyshev (MVUE) UCL	109.3
95% Modified-t UCL	118.1	99% Chebyshev (MVUE) UCL	137.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.028	Data do not follow a Discernable Distribution (0.05)	
Theta Star	76.47		
nu star	109		
Approximate Chi Square Value (.05)	85.87	Nonparametric Statistics	
Adjusted Level of Significance	0.0455	95% CLT UCL	114.7
Adjusted Chi Square Value	85.3	95% Jackknife UCL	115.3
		95% Standard Bootstrap UCL	114.8
Anderson-Darling Test Statistic	7.277	95% Bootstrap-t UCL	182.7
Anderson-Darling 5% Critical Value	0.778	95% Hall's Bootstrap UCL	224.3
Kolmogorov-Smirnov Test Statistic	0.344	95% Percentile Bootstrap UCL	118.4
Kolmogorov-Smirnov 5% Critical Value	0.125	95% BCA Bootstrap UCL	141.9
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	174.2
		97.5% Chebyshev(Mean, Sd) UCL	215.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	296.8
95% Approximate Gamma UCL	99.76		
95% Adjusted Gamma UCL	100.4		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	174.2

ProUCL Output for 95% UCL Calculations by Subreach for Alternatives 2B, 3B, and 4B with 0 µg/kg Residual PCB Concentration (LnROS Method for Nondetect Data)

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	Z:\Projects\A1535\FS\xls\ProUCL\Input\UCL-Herrera-subreaches LnROS-B0residual.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Subreach 2A			
B0_2A			
General Statistics			
Number of Valid Observations	70	Number of Distinct Observations	27
Raw Statistics		Log-transformed Statistics	
Minimum	0	Log Statistics Not Avaliable	
Maximum	970		
Mean	82		
Median	0		
SD	206.2		
Coefficient of Variation	2.515		
Skewness	3.258		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.359	Not Available	
Lilliefors Critical Value	0.106		
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	123.1	95% H-UCL	N/A
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	123.1	95% Adjusted-CLT UCL	132.8
		95% Modified-t UCL	124.7
Gamma Distribution Test		Data Distribution	
Gamma Statistics Not Available		Data do not follow a Discernable Distribution (0.05)	
Potential UCL to Use			
Use 95% Chebyshev (Mean, Sd) UCL	189.4	95% CLT UCL	122.5
		95% Jackknife UCL	123.1
		95% Standard Bootstrap UCL	121.7
		95% Bootstrap-t UCL	141.9
		95% Hall's Bootstrap UCL	129.5
		95% Percentile Bootstrap UCL	123.2
		95% BCA Bootstrap UCL	135
		95% Chebyshev(Mean, Sd) UCL	189.4
		97.5% Chebyshev(Mean, Sd) UCL	235.9
		99% Chebyshev(Mean, Sd) UCL	327.3

Subreach 2B			
B0_2B			
General Statistics			
Number of Valid Observations	79	Number of Distinct Observations	31
Raw Statistics		Log-transformed Statistics	
Minimum	0	Log Statistics Not Avaliable	
Maximum	8000		
Mean	135.9		
Median	0		
SD	904		
Coefficient of Variation	6.654		
Skewness	8.667		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.457	Not Available	
Lilliefors Critical Value	0.0997		
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	305.2	95% H-UCL	N/A
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	305.2	95% Adjusted-CLT UCL	409.1
		95% Modified-t UCL	321.7
Gamma Distribution Test		Data Distribution	
Gamma Statistics Not Available		Data do not follow a Discernable Distribution (0.05)	
Potential UCL to Use			
Use 95% Chebyshev (Mean, Sd) UCL	579.2	95% CLT UCL	303.1
		95% Jackknife UCL	305.2
		95% Standard Bootstrap UCL	301.7
		95% Bootstrap-t UCL	2071
		95% Hall's Bootstrap UCL	1557
		95% Percentile Bootstrap UCL	334
		95% BCA Bootstrap UCL	475.7
		95% Chebyshev(Mean, Sd) UCL	579.2
		97.5% Chebyshev(Mean, Sd) UCL	771
		99% Chebyshev(Mean, Sd) UCL	1148

Subreach 3A			
B0_3A			
General Statistics			
Number of Valid Observations	104	Number of Distinct Observations	45
Raw Statistics		Log-transformed Statistics	
Minimum	0	Log Statistics Not Avaliable	
Maximum	9400		
Mean	185		
Median	0.783		
SD	1137		
Coefficient of Variation	6.146		
Skewness	7.305		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.468	Not Available	
Lilliefors Critical Value	0.0869		
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	370.1	95% H-UCL	N/A
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	370.1	95% Adjusted-CLT UCL	453.8
		95% Modified-t UCL	383.4
Gamma Distribution Test		Data Distribution	
Gamma Statistics Not Available		Data do not follow a Discernable Distribution (0.05)	
Potential UCL to Use			
Use 95% Chebyshev (Mean, Sd) UCL	671	95% CLT UCL	368.4
		95% Jackknife UCL	370.1
		95% Standard Bootstrap UCL	372
		95% Bootstrap-t UCL	3272
		95% Hall's Bootstrap UCL	2220
		95% Percentile Bootstrap UCL	372.4
		95% BCA Bootstrap UCL	488.5
		95% Chebyshev(Mean, Sd) UCL	671
		97.5% Chebyshev(Mean, Sd) UCL	881.3
		99% Chebyshev(Mean, Sd) UCL	1294

Subreach 3B			
B_3B			
General Statistics			
Number of Valid Observations	46	Number of Distinct Observations	36
Raw Statistics		Log-transformed Statistics	
Minimum	6.847	Minimum of Log Data	1.924
Maximum	840	Maximum of Log Data	6.733
Mean	103.4	Mean of log Data	3.878
Median	40.46	SD of log Data	1.117
SD	172.9		
Coefficient of Variation	1.673		
Skewness	2.875		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.553	Shapiro Wilk Test Statistic	0.919
Shapiro Wilk Critical Value	0.945	Shapiro Wilk Critical Value	0.945
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	146.2	95% H-UCL	135.8
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	164.8
95% Adjusted-CLT UCL	156.8	97.5% Chebyshev (MVUE) UCL	198
95% Modified-t UCL	148	99% Chebyshev (MVUE) UCL	263
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.747	Data do not follow a Discernable Distribution (0.05)	
Theta Star	138.5		
nu star	68.68		
Approximate Chi Square Value (.05)	50.61	Nonparametric Statistics	
Adjusted Level of Significance	0.0448	95% CLT UCL	145.3
Adjusted Chi Square Value	50.1	95% Jackknife UCL	146.2
		95% Standard Bootstrap UCL	144.8
Anderson-Darling Test Statistic	3.612	95% Bootstrap-t UCL	169.4
Anderson-Darling 5% Critical Value	0.789	95% Hall's Bootstrap UCL	158.1
Kolmogorov-Smirnov Test Statistic	0.252	95% Percentile Bootstrap UCL	148.6
Kolmogorov-Smirnov 5% Critical Value	0.136	95% BCA Bootstrap UCL	159.9
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	214.5
		97.5% Chebyshev(Mean, Sd) UCL	262.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	357
95% Approximate Gamma UCL	140.3		
95% Adjusted Gamma UCL	141.7		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	357

Subreach 4A			
B_4A			
General Statistics			
Number of Valid Observations	97	Number of Distinct Observations	77
Raw Statistics		Log-transformed Statistics	
Minimum	4.877	Minimum of Log Data	1.584
Maximum	850	Maximum of Log Data	6.745
Mean	52.56	Mean of log Data	3.196
Median	23.26	SD of log Data	0.98
SD	122.8		
Coefficient of Variation	2.338		
Skewness	4.89		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.367	Lilliefors Test Statistic	0.162
Lilliefors Critical Value	0.09	Lilliefors Critical Value	0.09
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	73.27	95% H-UCL	49.16
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	59.46
95% Adjusted-CLT UCL	79.69	97.5% Chebyshev (MVUE) UCL	68.22
95% Modified-t UCL	74.3	99% Chebyshev (MVUE) UCL	85.43
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.761	Data do not follow a Discernable Distribution (0.05)	
Theta Star	69.08		
nu star	147.6		
Approximate Chi Square Value (.05)	120.5	Nonparametric Statistics	
Adjusted Level of Significance	0.0475	95% CLT UCL	73.07
Adjusted Chi Square Value	120.1	95% Jackknife UCL	73.27
		95% Standard Bootstrap UCL	72.79
Anderson-Darling Test Statistic	9.752	95% Bootstrap-t UCL	87.82
Anderson-Darling 5% Critical Value	0.793	95% Hall's Bootstrap UCL	78.75
Kolmogorov-Smirnov Test Statistic	0.253	95% Percentile Bootstrap UCL	74.47
Kolmogorov-Smirnov 5% Critical Value	0.0943	95% BCA Bootstrap UCL	83.29
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	106.9
		97.5% Chebyshev(Mean, Sd) UCL	130.5
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	176.7
95% Approximate Gamma UCL	64.36		
95% Adjusted Gamma UCL	64.56		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	106.9

Subreach 4B			
B_4B			
General Statistics			
Number of Valid Observations	53	Number of Distinct Observations	45
Raw Statistics		Log-transformed Statistics	
Minimum	20.78	Minimum of Log Data	3.034
Maximum	1100	Maximum of Log Data	7.003
Mean	78.61	Mean of log Data	3.833
Median	38.47	SD of log Data	0.785
SD	159.7		
Coefficient of Variation	2.031		
Skewness	5.478		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.415	Lilliefors Test Statistic	0.239
Lilliefors Critical Value	0.122	Lilliefors Critical Value	0.122
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	115.3	95% H-UCL	78.93
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	95.13
95% Adjusted-CLT UCL	132.3	97.5% Chebyshev (MVUE) UCL	109.3
95% Modified-t UCL	118.1	99% Chebyshev (MVUE) UCL	137.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.028	Data do not follow a Discernable Distribution (0.05)	
Theta Star	76.47		
nu star	109		
Approximate Chi Square Value (.05)	85.87	Nonparametric Statistics	
Adjusted Level of Significance	0.0455	95% CLT UCL	114.7
Adjusted Chi Square Value	85.3	95% Jackknife UCL	115.3
		95% Standard Bootstrap UCL	115.4
Anderson-Darling Test Statistic	7.277	95% Bootstrap-t UCL	176.3
Anderson-Darling 5% Critical Value	0.778	95% Hall's Bootstrap UCL	226.3
Kolmogorov-Smirnov Test Statistic	0.344	95% Percentile Bootstrap UCL	119.1
Kolmogorov-Smirnov 5% Critical Value	0.125	95% BCA Bootstrap UCL	140
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	174.2
		97.5% Chebyshev(Mean, Sd) UCL	215.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	296.8
95% Approximate Gamma UCL	99.76		
95% Adjusted Gamma UCL	100.4		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	174.2

ProUCL Output for 95% UCL Calculations by Subreach for Alternatives 2B, 3B, and 4B with 100 µg/kg Residual PCB Concentration (LnROS Method for Nondetect Data)

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	Z:\Projects\A1535\FS\xls\ProUCL\Input\UCL-Herrera-subreaches LnROS-B100residual.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Subreach 2A			
B100_2A			
General Statistics			
Number of Valid Observations	70	Number of Distinct Observations	27
Raw Statistics		Log-transformed Statistics	
Minimum	1.849	Minimum of Log Data	0.615
Maximum	970	Maximum of Log Data	6.877
Mean	133.4	Mean of log Data	4.234
Median	100	SD of log Data	1.259
SD	191.1		
Coefficient of Variation	1.432		
Skewness	3.287		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.384	Lilliefors Test Statistic	0.316
Lilliefors Critical Value	0.106	Lilliefors Critical Value	0.106
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	171.5	95% H-UCL	222.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	274.6
95% Adjusted-CLT UCL	180.6	97.5% Chebyshev (MVUE) UCL	328.8
95% Modified-t UCL	173	99% Chebyshev (MVUE) UCL	435.2
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.859	Data do not follow a Discernable Distribution (0.05)	
Theta Star	155.3		
nu star	120.3		
Approximate Chi Square Value (.05)	95.93	Nonparametric Statistics	
Adjusted Level of Significance	0.0466	95% CLT UCL	171
Adjusted Chi Square Value	95.47	95% Jackknife UCL	171.5
		95% Standard Bootstrap UCL	170.7
Anderson-Darling Test Statistic	4.974	95% Bootstrap-t UCL	191.6
Anderson-Darling 5% Critical Value	0.786	95% Hall's Bootstrap UCL	176.4
Kolmogorov-Smirnov Test Statistic	0.272	95% Percentile Bootstrap UCL	170.9
Kolmogorov-Smirnov 5% Critical Value	0.11	95% BCA Bootstrap UCL	179
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	233
		97.5% Chebyshev(Mean, Sd) UCL	276.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	360.7
95% Approximate Gamma UCL	167.3		
95% Adjusted Gamma UCL	168.1		
Potential UCL to Use		Use 97.5% Chebyshev (Mean, Sd) UCL	276.1

Subreach 2B			
B100_2B			
General Statistics			
Number of Valid Observations	79	Number of Distinct Observations	31
Raw Statistics		Log-transformed Statistics	
Minimum	3.893	Minimum of Log Data	1.359
Maximum	8000	Maximum of Log Data	8.987
Mean	191.6	Mean of log Data	4.224
Median	100	SD of log Data	1.018
SD	896.9		
Coefficient of Variation	4.682		
Skewness	8.685		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.481	Lilliefors Test Statistic	0.291
Lilliefors Critical Value	0.0997	Lilliefors Critical Value	0.0997
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	359.5	95% H-UCL	148.6
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	181.4
95% Adjusted-CLT UCL	462.9	97.5% Chebyshev (MVUE) UCL	210.8
95% Modified-t UCL	376	99% Chebyshev (MVUE) UCL	268.5
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.585	Data do not follow a Discernable Distribution (0.05)	
Theta Star	327.4		
nu star	92.43		
Approximate Chi Square Value (.05)	71.26	Nonparametric Statistics	
Adjusted Level of Significance	0.047	95% CLT UCL	357.5
Adjusted Chi Square Value	70.91	95% Jackknife UCL	359.5
		95% Standard Bootstrap UCL	359.5
Anderson-Darling Test Statistic	12.97	95% Bootstrap-t UCL	2323
Anderson-Darling 5% Critical Value	0.809	95% Hall's Bootstrap UCL	1178
Kolmogorov-Smirnov Test Statistic	0.438	95% Percentile Bootstrap UCL	388.4
Kolmogorov-Smirnov 5% Critical Value	0.105	95% BCA Bootstrap UCL	520.8
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	631.4
		97.5% Chebyshev(Mean, Sd) UCL	821.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1196
95% Approximate Gamma UCL	248.5		
95% Adjusted Gamma UCL	249.7		
Potential UCL to Use		Use 97.5% Chebyshev (Mean, Sd) UCL	821.7

Subreach 3A			
B100_3A			
General Statistics			
Number of Valid Observations	104	Number of Distinct Observations	44
Raw Statistics		Log-transformed Statistics	
Minimum	1.566	Minimum of Log Data	0.449
Maximum	9400	Maximum of Log Data	9.148
Mean	235	Mean of log Data	4.037
Median	100	SD of log Data	1.309
SD	1130		
Coefficient of Variation	4.808		
Skewness	7.311		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.485	Lilliefors Test Statistic	0.283
Lilliefors Critical Value	0.0869	Lilliefors Critical Value	0.0869
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	418.9	95% H-UCL	184.3
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	228.1
95% Adjusted-CLT UCL	502.1	97.5% Chebyshev (MVUE) UCL	269.9
95% Modified-t UCL	432.2	99% Chebyshev (MVUE) UCL	352.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.447	Data do not follow a Discernable Distribution (0.05)	
Theta Star	526.3		
nu star	92.89		
Approximate Chi Square Value (.05)	71.66	Nonparametric Statistics	
Adjusted Level of Significance	0.0477	95% CLT UCL	417.3
Adjusted Chi Square Value	71.4	95% Jackknife UCL	418.9
		95% Standard Bootstrap UCL	413.7
Anderson-Darling Test Statistic	16.26	95% Bootstrap-t UCL	2599
Anderson-Darling 5% Critical Value	0.83	95% Hall's Bootstrap UCL	2024
Kolmogorov-Smirnov Test Statistic	0.399	95% Percentile Bootstrap UCL	441.1
Kolmogorov-Smirnov 5% Critical Value	0.0941	95% BCA Bootstrap UCL	536.6
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	718
		97.5% Chebyshev(Mean, Sd) UCL	927
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1337
95% Approximate Gamma UCL	304.6		
95% Adjusted Gamma UCL	305.7		
Potential UCL to Use		Use 97.5% Chebyshev (Mean, Sd) UCL	927

Subreach 3B			
B_3B			
General Statistics			
Number of Valid Observations	46	Number of Distinct Observations	36
Raw Statistics		Log-transformed Statistics	
Minimum	6.847	Minimum of Log Data	1.924
Maximum	840	Maximum of Log Data	6.733
Mean	103.4	Mean of log Data	3.878
Median	40.46	SD of log Data	1.117
SD	172.9		
Coefficient of Variation	1.673		
Skewness	2.875		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.553	Shapiro Wilk Test Statistic	0.919
Shapiro Wilk Critical Value	0.945	Shapiro Wilk Critical Value	0.945
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	146.2	95% H-UCL	135.8
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	164.8
95% Adjusted-CLT UCL	156.8	97.5% Chebyshev (MVUE) UCL	198
95% Modified-t UCL	148	99% Chebyshev (MVUE) UCL	263
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.747	Data do not follow a Discernable Distribution (0.05)	
Theta Star	138.5		
nu star	68.68		
Approximate Chi Square Value (.05)	50.61	Nonparametric Statistics	
Adjusted Level of Significance	0.0448	95% CLT UCL	145.3
Adjusted Chi Square Value	50.1	95% Jackknife UCL	146.2
		95% Standard Bootstrap UCL	144.9
Anderson-Darling Test Statistic	3.612	95% Bootstrap-t UCL	173.1
Anderson-Darling 5% Critical Value	0.789	95% Hall's Bootstrap UCL	154.9
Kolmogorov-Smirnov Test Statistic	0.252	95% Percentile Bootstrap UCL	148.7
Kolmogorov-Smirnov 5% Critical Value	0.136	95% BCA Bootstrap UCL	158.5
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	214.5
		97.5% Chebyshev(Mean, Sd) UCL	262.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	357
95% Approximate Gamma UCL	140.3		
95% Adjusted Gamma UCL	141.7		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	357

Subreach 4A			
B_4A			
General Statistics			
Number of Valid Observations	97	Number of Distinct Observations	77
Raw Statistics		Log-transformed Statistics	
Minimum	4.877	Minimum of Log Data	1.584
Maximum	850	Maximum of Log Data	6.745
Mean	52.56	Mean of log Data	3.196
Median	23.26	SD of log Data	0.98
SD	122.8		
Coefficient of Variation	2.338		
Skewness	4.89		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.367	Lilliefors Test Statistic	0.162
Lilliefors Critical Value	0.09	Lilliefors Critical Value	0.09
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	73.27	95% H-UCL	49.16
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	59.46
95% Adjusted-CLT UCL	79.69	97.5% Chebyshev (MVUE) UCL	68.22
95% Modified-t UCL	74.3	99% Chebyshev (MVUE) UCL	85.43
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.761	Data do not follow a Discernable Distribution (0.05)	
Theta Star	69.08		
nu star	147.6		
Approximate Chi Square Value (.05)	120.5	Nonparametric Statistics	
Adjusted Level of Significance	0.0475	95% CLT UCL	73.07
Adjusted Chi Square Value	120.1	95% Jackknife UCL	73.27
		95% Standard Bootstrap UCL	73.84
Anderson-Darling Test Statistic	9.752	95% Bootstrap-t UCL	89.98
Anderson-Darling 5% Critical Value	0.793	95% Hall's Bootstrap UCL	77.82
Kolmogorov-Smirnov Test Statistic	0.253	95% Percentile Bootstrap UCL	75.12
Kolmogorov-Smirnov 5% Critical Value	0.0943	95% BCA Bootstrap UCL	79.73
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	106.9
		97.5% Chebyshev(Mean, Sd) UCL	130.5
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	176.7
95% Approximate Gamma UCL	64.36		
95% Adjusted Gamma UCL	64.56		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	106.9

Subreach 4B			
B_4B			
General Statistics			
Number of Valid Observations	53	Number of Distinct Observations	45
Raw Statistics		Log-transformed Statistics	
Minimum	20.78	Minimum of Log Data	3.034
Maximum	1100	Maximum of Log Data	7.003
Mean	78.61	Mean of log Data	3.833
Median	38.47	SD of log Data	0.785
SD	159.7		
Coefficient of Variation	2.031		
Skewness	5.478		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.415	Lilliefors Test Statistic	0.239
Lilliefors Critical Value	0.122	Lilliefors Critical Value	0.122
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	115.3	95% H-UCL	78.93
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	95.13
95% Adjusted-CLT UCL	132.3	97.5% Chebyshev (MVUE) UCL	109.3
95% Modified-t UCL	118.1	99% Chebyshev (MVUE) UCL	137.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.028	Data do not follow a Discernable Distribution (0.05)	
Theta Star	76.47		
nu star	109		
Approximate Chi Square Value (.05)	85.87	Nonparametric Statistics	
Adjusted Level of Significance	0.0455	95% CLT UCL	114.7
Adjusted Chi Square Value	85.3	95% Jackknife UCL	115.3
		95% Standard Bootstrap UCL	114.5
Anderson-Darling Test Statistic	7.277	95% Bootstrap-t UCL	182.5
Anderson-Darling 5% Critical Value	0.778	95% Hall's Bootstrap UCL	226.8
Kolmogorov-Smirnov Test Statistic	0.344	95% Percentile Bootstrap UCL	119.9
Kolmogorov-Smirnov 5% Critical Value	0.125	95% BCA Bootstrap UCL	140.9
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	174.2
		97.5% Chebyshev(Mean, Sd) UCL	215.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	296.8
95% Approximate Gamma UCL	99.76		
95% Adjusted Gamma UCL	100.4		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	174.2